ABOUT THIS CHAPTER

This chapter provides an overview of flood risk in the Sacramento-San Joaquin Delta (Delta), current flood management efforts, and the most pertinent agencies and regulations. It details the Delta Stewardship Council's (Council) core strategies to reduce risk to people, property, and State interests in the Delta. These core strategies form the basis of the four policies and fifteen recommendations found at the end of the chapter:

- Continue to prepare for Delta flood emergencies
- Modernize levee information management
- Prioritize investment in Delta flood management
- Update funding strategies
- Manage rural floodplains to avoid increased flood risk
- Protect and expand floodways, floodplains, and bypasses
- Renew assurances of federal assistance for post-disaster levee reconstruction
- Limit State liability

Reducing flood risks in the Delta also relies on locating urban development in the cities where levees are stronger (as proposed in Chapter 5) and retaining rural lands for agriculture, so that development in the most flood-prone areas is minimized.

RELEVANT LEGISLATION

Water Code sections 85305, 85306, 85307, and 85309 require the Delta Plan to include or otherwise consider specific components to attempt to reduce risk.

> *85305(a) The Delta Plan shall attempt to reduce risks to people, property, and state interests in the Delta by promoting effective emergency preparedness appropriate land uses, and strategic levee investments.*
>
> *(b) The council may incorporate into the Delta Plan the emergency preparedness and response strategies for the Delta developed by the California Emergency Management Agency pursuant to Section 12994.5.*
>
> *85306 The council, in consultation with the Central Valley Flood Protection Board, shall recommend in the Delta Plan priorities for state investments in levee operation, maintenance, and improvements in the Delta, including both levees that are a part of the State Plan of Flood Control and non-project levees.*
>
> *85307(a) The Delta Plan may identify actions to be taken outside of the Delta, if those actions are determined to significantly reduce flood risks in the Delta. (b) The Delta Plan may include local plans of flood protection. (c) The council, in consultation with the Department of Transportation, may address in the Delta Plan the effects of climate change and sea level rise on the three state highways that cross the Delta. (d) The council, in consultation with the State Energy*

Resources Conservation and Development Commission and the Public Utilities Commission, may incorporate into the Delta Plan additional actions to address the needs of Delta energy development, energy storage, and energy transmission and distribution.

85309 The department, in consultation with the United States Army Corps of Engineers and the Central Valley Flood Protection Board, shall consider a proposal to coordinate flood and water supply operations of the State Water Project and the federal Central Valley Project, and submit the proposal to the council for consideration for incorporation into the Delta Plan. In drafting the proposal, the department shall consider all related actions set forth in the Strategic Plan.

Reduce Risk to People, Property, and State Interests in the Delta

Reducing flood risks to people, property, and State interests is critical to achieving the Delta Reform Act's coequal goals and protecting the Delta as a place. The Legislature has found that the Delta is "inherently flood-prone," and that further improvements and continuing maintenance of the levee system will not resolve all flood risks (Public Resources Code section 29704). Living with risk, whether from floods, earthquakes, fires, coastal storms, or other hazards, is often part of life in California. The Delta's hazards, however, are exceptional because they affect so many State interests, including the reliability of its water supplies, the health of the Delta's ecosystem, and the qualities that make the Delta an attractive place to live, work, and recreate.

To reduce these risks to people, property, and State interests in the Delta, the Delta Reform Act requires that the Delta Plan promote effective emergency response and preparedness, appropriate land use, and strategic investments in levees (Water Code section 85305). The Delta Reform Act also directs the Council, in consultation with the Central Valley Flood Protection Board (CVFPB), to recommend priorities for State investments in levee operation, maintenance, and improvements in the Delta, including both levees that are a part of the State Plan of Flood Control and nonproject levees (Water Code section 85306).

The Council envisions a future in which risks of flooding in the Delta are reduced, despite an increase in sea levels and altered runoff patterns. The Council sees a future where Delta residents, local governments, and businesses are better prepared to respond when floods threaten. The Council envisions a future where bypasses are expanded; channels are improved; and strong, well-maintained levees protect local communities—but also protect State interests in a more reliable water supply for California and a protected and restored Delta ecosystem. These improvements will include new or expanded floodways and bypasses, maintaining and improving levees, and floodproofing new development. The Council envisions that rural areas and the Delta's legacy communities will also be protected from flood risks by careful land use planning that discourages urban development in flood-threatened areas. The Council envisions that flood management will draw on a variety of funding tools, including

greater payments by those who benefit from the Delta's levees. State funds for desired projects will be focused at State interests in the Delta, but some of that activity will protect local interests as well. Federal, State, and local agencies will respond cooperatively to flood disasters, working together to recover vital infrastructure, mitigate economic damage, restore the ecosystem, and encourage long-term resiliency.

Eliminating flood risks will be impossible, but prudent planning, reasonable land development, and improved flood management will significantly reduce risk, and serve the coequal goals of a more reliable water supply, and a protected and restored Delta ecosystem.

Delta Hazards Threaten Both Coequal Goals and the Delta as a Place

The threats that flooding, earthquakes, and other hazards pose to the Delta imperil California's water supplies and the health of the Delta ecosystem. The channels that convey water through the Delta to users in the Bay Area, San Joaquin Valley, or Southern California, and the islands that prevent saltwater intrusion into Delta water supplies depend upon levees for their preservation. Should the levees that protect these channels fail, the impacts on water supplies could be felt statewide. Improving these Delta levees is an investment in water supply reliability. Another way to reduce these risks is for areas that use Delta water to develop plans for possible interruption of these supplies in a catastrophic event, as recommended in Chapter 3. Integrating water supply and flood control efforts is also important to optimize the management of the multipurpose reservoirs that store water for the Central Valley Project (CVP), State Water Project (SWP), and other water users. For example, a potential benefit of wide flood bypasses leading to the Delta may be greater flexibility in these reservoirs' operations, creating new opportunities to manage water supplies or generate hydroelectric power, while also contributing to ecosystem restoration as described below.

The Delta levees also affect the health of the ecosystem. Many birds, such as waterfowl or sandhill cranes, thrive in areas that depend on levees for their management. In some locations, careful removal or breaching of levees may create new habitats that benefit fish, wildlife, and the ecosystem. Fish and wildlife habitats can be improved by thoughtful design of levee margins bordering sloughs and river channels. Setting levees back deliberately, when feasible, can create both more capacity for flood flows and more habitat for fish and wildlife. But unplanned levee failures often create weed-infested depths that harbor nonnative species rather than refuges for smelt, salmon, or other preferred species. Changes in the area protected by levees also alter water circulation through the Delta, changing the benefit of flows released to protect its ecosystem.

The Delta's residents, farms, and businesses also depend on its levees. They shape the Delta landscape, protecting its farms and communities from destruction. The levee system is the foundation on which the entire Delta economy is built, the Delta Protection Commission's (DPC's) *Economic Sustainability Plan* reports (DPC 2012). Delta

residents built the levee system over generations, and they are keenly interested in its maintenance and improvement. (See sidebar, Delta Disaster Recalled, for an example of the consequences of levee failure.)

DELTA DISASTER RECALLED (SIDEBAR)

On a moonlit Wednesday night in June 1972, the San Joaquin River flowed slowly after one of the driest winters on record. It gnawed at the Andrus Island levee 6 miles south of Isleton between Bruno's Yacht Harbor and Spindrift Resort, opening a small hole that grew rapidly. By the time sheriff's deputies arrived on scene shortly after 1 a.m., the river had carved a 100-foot break. By 3 a.m., water covered Highway 12. Shortly after sunrise, the breach had grown to 300 feet, and volunteers were hard at work on a 1.5-mile-long bow levee to protect Isleton.

The battle to save Isleton continued throughout the day, but a rising tide and waves created by 30- to 45-mile-per-hour Delta winds hampered efforts. Within a few hours, officials ordered the evacuation of 1,400 Isleton residents and an additional 1,500 residents of Andrus and Brannan islands. At 9:45 p.m. Thursday, the bow levee breached, and a wall of water rushed into the low-lying residential area of Isleton. Although the city's business district was spared, almost all of Andrus Island and portions of Brannan Island were flooded, in some places up to 20 feet deep.

Then-Governor Ronald Reagan declared the islands a disaster area and asked President Richard Nixon to do the same. Over the next 6 months, the levee was repaired, the 12,000-acre lake that had been Brannan and Andrus Islands was drained, and life began returning to normal. A full year after the levee break, however, more than one-third of the residents had neither moved back into their homes nor begun to rebuild.

Officials estimated that damages were $21.8 million, slightly more than half of that from crop loss and saltwater damage to farmland. The cost for levee repairs was put at $800,000, and $500,000 went to pump the 20 square miles of flooded land dry. More than $1.5 million in federal disaster relief was made available. No definitive cause was ever determined for the levee breach, and a subsequent court case absolved the State of liability (DWR 1973, Sacramento River Delta Historical Society 1996).

Flood Risk in the Delta

The Delta is an inherently floodprone area. This section provides an overview of the causes and consequences of floods in the Delta. The Sacramento and San Joaquin rivers collectively drain approximately 42,500 square miles of land. Before the Delta was modified by levees and other human structures, these rivers' natural flows overflowed the Delta's low-lying islands and floodplains for long periods each spring. The biggest floods occurred when warm Pacific storms swept in from the west and southwest, picking up moisture over the ocean and causing torrential rains when intercepted by the mountains surrounding the Central Valley. The risks of flooding were increased when

large amounts of sediment were discharged to Central Valley rivers during the Gold Rush, choking their channels and raising their beds above their natural levels and surrounding lands.

Today, flooding of the Delta's complex labyrinth of islands and waterways is prevented by its levees. This system of flood control is supplemented by the flood facilities of the Sacramento River and San Joaquin River flood control projects and multipurpose reservoirs such as Shasta, Folsom, and Millerton lakes and Lake Oroville on the Sacramento and San Joaquin rivers and their tributaries, which hold back floodwater and provide water supplies and other benefits described in Chapter 3.

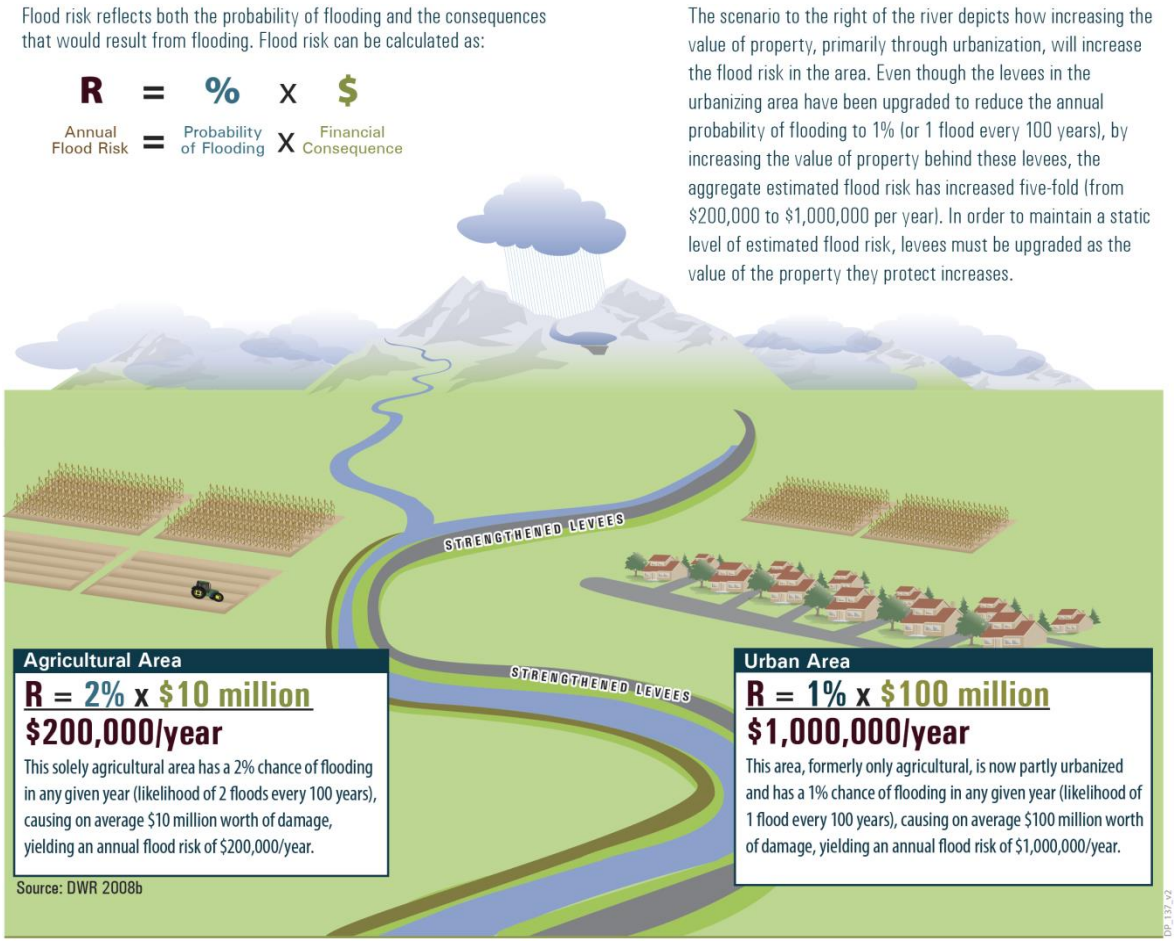
Many Delta levees were initially constructed more than a century ago. Levee-building materials and equipment that were state-of-the-art then seem primitive today. History has shown that structural failures of the levee system occur as a result of extraordinary events, imperfect knowledge, and imperfect materials. Delta levees face potential threats such as large runoff events, extreme high tides, wind-generated waves, earthquakes, subsidence, and sea level rise. Individually, each of these threats is enough to cause serious concern; together, they represent the potential for catastrophic disruption of the Delta and its economic and ecological services.

A mass or even partial failure of the levee system would have real life-and-death impacts and property losses that could total billions of dollars. Delta flooding could interrupt the conveyance of water through the Delta for the SWP, the CVP, in-Delta users, the Contra Costa Water District, the cities of Antioch and Stockton, and others who depend on the Delta for reliable water supplies (see Chapter 3 for a discussion of water supply reliability). Levee failures could also damage key features of the Delta ecosystem, including managed wetlands in Suisun Marsh and habitats of wintering greater sandhill cranes at Staten Island and nearby tracts. Unplanned levee failure could also degrade water quality in the Delta, because tidewaters would flood into the bowl created by subsidence of Delta islands. These failures would draw saltwater from San Francisco Bay and pollute Delta water with flood debris, farm chemicals, and other pollutants.

Levee failures also could flood homes, farms, and businesses, including historic structures in the legacy communities, and interrupt recreation and tourism. As noted in Chapter 5, about 116,000 residential structures are located in the 100-year floodplain of the Delta, mostly near Sacramento, West Sacramento, and Stockton. Also, 8,000 residences are below mean higher high water (DWR 2008b). Serious consequences also could result from flood-related damage to critical infrastructure in the Delta, including radio, cellular telephone, and television transmission towers; electrical transmission lines, including Pacific Gas and Electric Company, Sacramento Municipal Utility District, and Western Area Power Administration lines; natural gas pipelines serving local gas fields and regional transmission systems; petroleum pipelines; the East Bay Municipal Utility District aqueduct; several railroads; three state highways; and three interstate highways (DWR 2011a; Arcadis 2016b).

In simplistic terms, the concept of flood risk can be described as the likelihood of a flood event occurring multiplied by the consequences of that event. To many, flood risk simply means the chance a storm event will overwhelm the flood control system to some extent. Figure 7-1 illustrates the variables, namely the probability of flooding and the financial consequences. However, there are many other causes of flood risk, and the consequences can be far more complicated than the immediate damage to property.

Understanding Delta Flood Risk



Floods

Flooding during winter storms that result in high water surface elevations and high winds has been a common cause of levee failures in the Delta. For example, the Sacramento River at Rio Vista may flow in excess of 300,000 cubic feet per second (cfs) during winter and early spring floods, 30 times typical late-summer flows of 10,000 cfs. Peak discharges place high stress on Delta levees and can create flood conditions, especially when coupled with high tides.

The likelihood of levee failures caused by high water is substantial, based on the historical performance of these levees over the last century. During the last century, there have been more than 140 levee failures and island inundations, most of which

occurred during flood seasons (DWR 2005). High water in the Delta can overtop levees, as well as increase the hydrostatic pressure on levees and their foundations, causing instability and increasing the risk of failure due to through-levee and/or under-levee seepage. Most levee failures in the Delta have occurred during winter storms and related high-water conditions, often in conjunction with high tides and strong winds.

Earthquakes

The Delta's levees are also threatened by the active seismic zones west of the Delta, including the San Andreas and Hayward faults. Less active faults underlie the Delta. A strong earthquake could damage Delta levees because of the potential for deformation or cracking of levees or liquefaction of levee embankments and foundations during strong ground shaking. Saturated levees composed of dredged materials in other parts of the country and the world have performed poorly during moderate to strong earthquake shaking (DWR 2009; Delta Stewardship Council Staff 2010a). Moderate earthquakes between 1979 and 1984 damaged nearby Delta levees, and many Delta islands' levees failed during floods within a year after the 1906 San Francisco earthquake (Deverel 2016). If a levee failed on an island subsided below sea level or during high flows or if a flood were to occur soon after an earthquake, the protected area could be inundated.

The risks of earthquakes causing levee breaches and island inundations in the Delta have long been recognized. A California Department of Water Resources (DWR) report begins:

> There is a long history of levee failures in the Delta that have resulted in extensive economic damage, but no failures of Delta levees are known to be directly attributable to earthquakes. Even so, two factors indicate a possible bleak picture for the future of many Delta levees. First, no serious causative quakes have occurred on the nearby major faults since the San Francisco earthquake of 1906. Second, the Delta levees of today are vastly different than those in the 1906 Delta, which had limited size and extent (DWR 1980).

The DWR Delta Risk Management Strategy Phase 1 study evaluated the performance of Delta levees under various seismic threat scenarios, and analyzed potential consequences for water supply, water quality, ecosystem values, and public health and safety. The study concluded that a major earthquake of magnitude 6.7 or greater in the vicinity of the Delta Region has a 62 percent probability of occurring sometime between 2003 and 2032 (DWR 2009). More recent investigations suggest earthquake-induced ground shaking affecting Delta levees may be less serious, but still worrisome (Delta Independent Science Board 2016; Deverel. 2016).

Figure 7-2 illustrates a potential flood scenario in which a 6.5-magnitude earthquake causes a 20-island failure. Although the probabilistic nature of earthquake prediction makes it difficult to quantify the timing and magnitude of seismic threats, it is important

to address the threats posed by earthquakes to the Delta levee system because of the potential adverse effects of such events.

High Tides and Sunny-day Hazards

Even without an earthquake or flood, Delta levees can fail during high tides or even on sunny days. Generally, these failures may be the result of a combination of high tide and pre-existing internal levee and foundation weaknesses caused by burrowing animals, internal erosion of the levee and foundation through time, and human interventions such as dredging or excavation at the toe of the levee (DWR 2008b). Examples of sunny-day failures include the Brannon Andrus Tract in 1972 and Upper Jones Tract in 2004. It is estimated that, based on current conditions, a sunny-day failure would occur once every 9 years on average (DWR and DFG 2008). One-third of the failures at peaty Delta islands since 1960 have been sunny-day failures (Delta Independent Science Board 2016).

Other hazards that affect the performance of Delta levees include encroachments, penetrations, and burrowing animals. Encroachments such as structures or farming practices on or close to the levee; penetrations of the levee, such as culverts or pipelines; and burrows created by rodents, especially beavers, muskrats, and squirrels, can weaken the structural integrity of levees. Because of unregulated historical construction, levees also contain many hidden hazards. Active programs of inspection, oversight, and maintenance are essential to minimize these hazards.

Simulation of Delta Salinity after a 20-island Failure Caused by a Magnitude 6.5 Earthquake

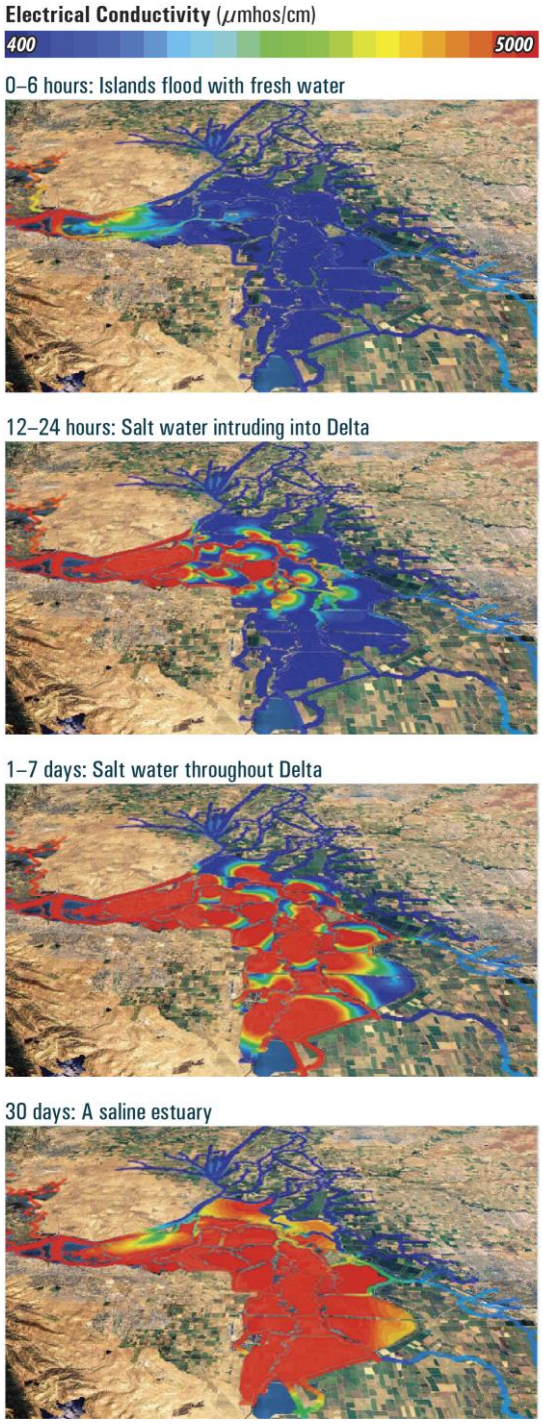


Figure 7-2 *Source: MWD 2010*

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Land Subsidence

Because of the land subsidence described in Chapter 5, much of the central Delta is below sea level. Some islands are 12 to 15 feet below sea level, requiring levees 20 to 25 feet in height that act as dikes, holding back water continually rather than only during seasonal floods or extreme tides. As subsidence progresses, accommodation space increases, and levees must be continually maintained, strengthened, and periodically raised to support the increasing hydraulic stresses (Miller 2008; Mount and Twiss 2005). The hydraulic stress also can drive seepage through and under levees, and place levee foundations under more stress. The thinning of the peat soil layer also leads to shallow or artesian groundwater conditions. More seepage onto islands will increase the drainage costs associated with additional pumping and decrease levee stability (Deverel and Leighton 2010; Deverel, Lucero, and Bachand 2015).

One approach to addressing subsidence can be the acquisition of conservation easements that provide for fallowing land adjoining levees on islands with deep peat. Acquisition of such easements is authorized through the Delta Levees Maintenance and Special Projects (Water Code section 12987(b) and 12316(e)), enabling use of this complement to levee improvement where appropriate.

Climate Change and Flood Risk

Climate change has major implications for the Delta, and especially for flood risk management. It is estimated that by the year 2100, sea levels at the Golden Gate may rise 17 to 66 inches (National Research Council, 2012; Natural Resources Agency 2014). Recent research suggests melting glacial ice may cause even higher rises in sea levels (Dennis, B. and Mooney, C, 2016). This chapter of the Delta Plan uses the higher end of the range of sea level rise forecast by the National Research Council (Arcadis 2015), consistent with advice from the Natural Resources Agency. The scenario anticipates sea level rising by 2050 by approximately two feet at the Golden Gate and the western end of Sherman Island, 20 inches at Mandeville or Venice Islands near the San Joaquin River's confluence with Middle and Old Rivers and six to eight inches at Walnut Grove. These higher water levels will put additional stress on levees, increasing their risk of failure. By 2050 rising sea levels will more than double the probability of flooding if levees are not just well-maintained but also improved (Arcadis. 2016b; Arcadis. 2017). Drainage of Delta islands will also be more difficult, impairing agriculture on which the finances of many reclamation districts' rely.

Climate change will also increase hydrologic variability and uncertainty, which is likely to result in more severe flooding over time. (DWR 2016_

Additionally, scientific understanding of large-scale precipitation events is growing, as demonstrated by the ARkStorm scenarios being investigated by the U.S. Geological Survey, which indicate that massive storms and subsequent flooding have occurred in the past and are likely to occur again (USGS 2011). Failure of significant parts of the Delta's flood management system may be unavoidable.

Adequacy of Flood Risk Data

The threats to Delta levees described above have been acknowledged for many years, but disagreements remain about the significance of the risks they pose. This update of the Delta Plan is based on the best, most up-to-date data available, compiled from more than 50 data sources and provided for public review and correction. Nevertheless, some Delta residents, reclamation district engineers, and scientists object that other reports or their firsthand knowledge provide contradictory information. In part this reflects continually changing conditions in the Delta, including land use, levee improvement and maintenance, subsidence, and other factors. In addition, the information about levee conditions and threats that is kept by the almost 100 agencies involved in maintaining the Delta levee network is not easily shared, but rather is often retained only in paper reports held by individual agencies or firms. This means that California does not have the clearest possible understanding of risks in the Delta or of how they can be most effectively reduced.

Informed decision making can be improved by gathering and widely sharing information about the Delta levee network using contemporary data management technology. Sharing this information has been urged for many years (DWR 1983; Central Valley Flood Protection Board 2016) and is required for project levees (Water Code section 9140). More transparency about the benefits gained through State-funded levee improvements can complement information about levee conditions, facilitating more comprehensive and timely assessment and reporting about the Delta levee network.

THE DELTA'S LEVEES

This section summarizes the current state of flood management planning for the Delta. To reduce the risk of flooding, Delta landowners, local governments, and State and federal agencies have planned and built an extensive levee system in the Delta, and significant flood control works upstream of the Delta. Other government flood control programs plan for emergency response in the event of floods, or help manage flood risks through land use planning, building standards, and flood insurance. The Delta Reform Act refers to these government-sponsored flood control programs in its provisions regarding covered actions (Water Code section 85057.5(a)(4)). The sidebar, What Is a Government-sponsored Flood Control Program?, highlights those programs referenced in statute; and proposed actions in the Delta that will have a significant impact on the implementation of one of these programs may be considered covered actions. Chapter 2 provides details about covered actions.

There are about 1,330 miles of project, nonproject, and other levees in the Delta and Suisun Marsh. These levees reduce flood risk for approximately 740,000 acres of land in the Delta. They define the Delta's physical characteristics; influence the reliability of its water supplies and its ecosystem health; and are critical to the Delta's residents, farms, businesses, cities, and legacy communities. Because many Delta levees protect land below sea level, they hold back water all day, year-round, rather than only during floods, and so are called "the hardest working levees" in America.

Differences in how levees are classified can influence reports about their length and condition. Approximately 65 percent of the levees in the Delta and all levees in the Suisun Marsh are owned or maintained by local agencies or private owners and are not part of the flood control projects on the Sacramento or San Joaquin rivers. Most of these are nonproject levees maintained by local reclamation districts created and funded by landowners, initially for the purpose of draining ("reclaiming") Delta islands and tracts. The reclamation districts continue to maintain levees and other water control facilities today. These nonproject levees are defined in Water Code section 12980(e).

The State-federal flood control projects on the Sacramento and San Joaquin rivers include approximately one-third, or about 380 miles, of the Delta's levees. Known as "project levees," they begin on the left bank of the Sacramento River at Sherman Island, and line most of the riverbanks, as well as the Sacramento River Deep Water Ship Channel and some connecting waterways, north to Sacramento and beyond. The Delta Cross Channel's control gates are an important feature of this levee system, closing during high flows to keep the Sacramento River's floodwaters out of the central Delta. The flood control project also includes the Yolo Bypass, the broad, managed floodplain in Yolo County west of West Sacramento. The wide bypass, which is confined by project levees, draws floodwater through weirs above Sacramento to lower flood heights on the Sacramento River and its tributaries, discharging back to the Delta above Rio Vista. The Yolo Bypass floods about once every 3 years, between December and February. On the San Joaquin River, project levees line the riverbanks from Old River to Stockton. Figure 7-3 shows the locations of project and nonproject levees in the Delta.

Recent evaluations show that some of the flood control project facilities on the Sacramento and San Joaquin rivers are not adequate. Because the system was intended partly to flush Gold Rush-era sediment from rivers and channels, the project levees were often built close to the riverbanks, and are prone to erosion. Many of the system's channels have inadequate capacity to carry the flows for which they were designed, and many levees do not meet contemporary design standards (DWR 2011c).

The CVFPB, as part of its responsibility to oversee the flood control projects on the Sacramento and San Joaquin rivers, has adopted regulations to control encroachments on the project and some of the streams that flow into it. It also regulates encroachments within designated floodways, which are the channels of a river or other watercourse and the adjacent land areas that convey floodwaters (California Code of Regulations [CCR], Title 23, Division 1, Chapter 1, Article 2, Section 4). In the Delta, designated floodways include the Cosumnes River's floodplain and the confluence of the San Joaquin River and the Stanislaus River upstream from Paradise Cut.

Some levees are neither project levees nor nonproject levees. These "unattributed levees" include hundreds of miles of levees in Suisun Marsh and the Delta, and are not part of any State-financed flood control program. They also include some levees that are no longer maintained along the perimeter of permanently flooded islands and no longer serve flood control or drainage purposes.

Other facilities throughout the Delta drain rainfall runoff from land into Delta channels. Local cities and districts own and maintain urban storm drains in developed areas. Stockton, Sacramento, West Sacramento, Lathrop, Manteca, and Tracy are Delta cities with storm drainage facilities. Most Delta islands have a network of agricultural drains and pumps to convey runoff to the Delta channels. Some Delta channels have been dredged to increase their capacity to carry floodwater and to obtain material for levee construction and maintenance.

Multipurpose reservoirs in the Sacramento and San Joaquin river watersheds that play a role in California's water supply also serve critically important roles in managing floods that affect the Delta. The CVP's Shasta, Folsom, and Millerton lakes and New Melones Reservoir; the SWP's Lake Oroville; and other reservoirs are operated in accordance with flood control rules established by U.S. Army Corps of Engineers (USACE), reserving space to capture flood flows that can be released downstream gradually so that channels are not overwhelmed.

Planning for Flood Management

Many planning efforts addressing flood management and emergency preparedness, response, and mitigation are under way, including the following:

- ***Central Valley Flood Protection Plan*** **(CVFPP).** This strategic plan for improving the flood control projects on the Sacramento and San Joaquin rivers recommends approaches for reducing flood risk and improving the flood control project, including expansion of the Yolo Bypass and setting back levees along Paradise Cut (DWR 2016b) (see sidebar, Central Valley Flood Protection Plan).
- **DWR's FloodSAFE Initiative.** In 2006, DWR launched FloodSAFE California—a multifaceted initiative to improve public safety through integrated flood management.
- ***Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force Report.*** This report responds to Water Code section 12994.5, which called for the task force to make recommendations to the Governor about Delta multi-hazard emergency response and recovery issues.
- **CVP and SWP Reoperation Studies.** DWR's Forecast-coordinated Operations Program and Systems Reoperation Program address reservoir operational criteria, as noted in Chapter 3.

The U.S. Army Corps of Engineers (USACE) has completed recent studies (2015) recommending improvement to the Delta's project levees protecting Sacramento's Pocket neighborhood and West Sacramento. Congress authorized federal participation in these projects in 2016. USACE studies are underway of potential improvements to Delta levees protecting metropolitan Stockton and at the Yolo Bypass. Another USACE study (2014) concluded there is no federal interest in the Delta's nonproject levees' improvement.

The Council considered the findings of these studies and incorporated them into the update of this Delta Plan chapter. The CVFPP and FloodSAFE include many concepts relevant to flood protection in the Delta.

The CVFPB, DWR, and USACE each play unique and critical roles in Delta flood risk management. Because of this, the Council's role in facilitation, coordination, and integration of various agencies and other parties is of particular importance. Frequent, ongoing collaboration with other State, federal, and local agencies to improve communication and coordination is essential to meeting the Delta Plan's flood management objectives.

WHAT IS A GOVERNMENT-SPONSORED FLOOD CONTROL PROGRAM? (Sidebar)

Any State or federal strategy, project, approval, funding, or other effort that is intended to reduce the likelihood and/or consequence of flooding of real property and/or improvements, including risks to people, property, and State interests in the Delta, that is carried out pursuant to applicable law, including, but not limited to, the following code:

- State Water Resources Law of 1945, Water Code section 12570 et seq.
- Sacramento-San Joaquin River Flood Control Projects (Flood Control Act of 1941, Public Law 77–228)
- Local Plans of Flood Protection (Water Code section 8201)
- Central Valley Flood Protection Plan (Water Code section 9600 et seq.)
- Delta Levees Special Flood Control Projects Program (Water Code section 12300 et seq.)
- Delta Levees Maintenance Subventions Program (Water Code section 12980 et seq.)
- Central Valley Flood Protection Board Authority (California Code of Regulations, Title 23, Division 1)
- National Flood Insurance Program (National Flood Insurance Act of 1968, 42 United States Code 4001 et seq., Public Law 90-448)

Central Valley Flood Protection Plan (Sidebar)

The Central Valley Flood Protection Act of 2008 directed DWR to prepare the CVFPP. The CVFPP is a flood management planning effort that addresses flood risks and ecosystem restoration opportunities in an integrated manner. It specifically proposes a systemwide approach to flood management for the areas currently protected by facilities of the State Plan of Flood Control (SPFC). The CVFPP was adopted by the

CVFPB in June 2012. It is expected that the CVFPP will be updated in 2017 and every 5 years thereafter.

The CVFPP proposes a system-wide approach to address the following issues:

- Physical improvements in the Sacramento and San Joaquin river basins
- Urban flood protection
- Small community flood protection
- Rural/Agricultural area flood protection
- System improvements
- Non-SPFC levees
- Ecosystem restoration opportunities
- Climate change considerations

The geographic scope of the CVFPP includes the portions of the Delta covered by the SPFC, including about 65 miles of urban, nonproject levees at Stockton; approximately two-thirds of Delta levees are not addressed in the CVFPP. The effects of systemwide improvements directed by the CVFPP and the potential of redirected impacts to areas within the Delta will be monitored by the Council to ensure alignment with the coequal goals and the Delta Reform Act. Additionally, the Council may, at its discretion, incorporate those portions of the CVFPP into Delta Plan to the extent that those portions promote the coequal goals (Water Code section 85350).

The 2017 CVFPP is a strategic, long-range plan describing a programmatic vision for flood system improvements over time. Because it is descriptive, not decisional feasibility studies and project-specific development activities will be conducted to implement it over the coming years. The Council will continue to monitor and provide input to those activities to ensure that Delta flood risk issues are considered. Flood system improvement actions undertaken upstream of the Delta are of particular concern if not coupled with in-Delta actions that reduce overall systemwide flood risk.

EXISTING LEVEE STANDARDS AND GUIDANCE

It is more important than ever that the Delta's levees are designed, constructed, and maintained to provide a level of flood risk reduction commensurate with the coequal goals and protection of the Delta's unique values as a place. Over the last few decades, State and federal agencies have developed guidelines and standards for levees. These standards and guidelines generally establish minimum criteria for levee design and maintenance. The standards include (1) the level of flood protection California has prescribed for the Central Valley's urban areas, (2) whether sufficient protection is provided by the levees to exempt development financed with federally backed mortgages from requirements to obtain flood insurance, and (3) whether property and infrastructure protected by the levees (including the levees themselves) may be eligible

for assistance in the event of a catastrophic emergency, including aid from USACE to rehabilitate levees damaged in an emergency.

Five levee standards and guidelines applicable to the Delta are discussed below (and shown on Figure 7-4); they are ordered from highest to lowest level of flood protection:

- DWR 200-year Urban Levee Protection (DWR - 200 Year): This standard goes beyond criteria for levee height and geometric design to include requirements for freeboard, slope stability, seepage/underseepage, erosion, settlement, and seismic stability (DWR 2011b). It is intended to protect against a flood that has a 0.5 percent chance of being equaled or exceeded in any given year (a 200-year level of flood protection). This urban levee standard is the only levee standard that specifically links land uses to levee criteria. State law requires that by 2025, floodprone urban areas with over 10,000 residents must meet this 200-year flood protection standard (Government Code section 65865.5(a)(3)). Compliance likely will be achieved by upgrading levees to meet DWR's 200-year design standard. Sacramento, West Sacramento, and Stockton are planning levee improvements to attain this level of protection.

  Very few levees in the Delta meet this standard because most Delta levees do not protect urban areas. Under existing law, rural levees are not required to meet this standard.

- FEMA 100-year (Base Flood) Protection (FEMA – 100 Year): This "insurance" standard, often called the "1 percent annual chance flood" level of protection, provides criteria that levees must meet to protect against the flooding that is the basis for FEMA's flood insurance rate maps (44 Code of Federal Regulations 65.10). It is often used with established USACE criteria to prescribe requirements for levee freeboard, slope stability, seepage/underseepage, erosion, and settlement. The standard generally does not address seismic stability. In communities where levees provide this level of flood protection, new developments are not required to meet federal floodproofing standards and can obtain federally guaranteed mortgages without purchasing flood insurance.
  Few Delta levees outside of cities meet this standard, and some urban levees need improvement to meet it.

- Bulletin 192-82. The plan for Delta levee improvement proposed by DWR when State funding for Delta levees began, Bulletin 192 (DWR 1975), proposed two levels of improvement: 100-year protection roughly equivalent to the FEMA 100-year standard for levees protecting areas with legacy communities, other unincorporated Delta towns, and other islands with more residents – Brannan, Andrus, and Bethel Islands and Hotchkiss, Shima, Wright-Elmwood, Walnut Grove, and Sargent Barnhart Tracts. Levee improvements on other islands used primarily for agriculture were to provide 50-year protection, with 1.5 feet of freeboard above the expected 300 year flood elevation. The plan anticipated that on a few islands, levee improvements would be uneconomical, a conclusion with

which the Legislature concurred (Water Code section 128981(b)). Bulletin 192 is endorsed as a conceptual plan to guide the formulation of projects to preserve the Delta levee system (Water Code section 12225). Bulletin 192-82, its update, provides guidance for the Delta Levees Maintenance Subventions Program (Water Code section 12987).

- Public Law 84-99 (PL 84-99): The PL 84-99 guideline is a minimum requirement established by USACE for levees that participate in its Rehabilitation and Inspection Program (33 United States Code 701n) (69 Stat. 186). The standard for levee geometry implies a minimum levee height and a slope stability factor of safety, but is not associated with a level of protection (such as a 100-year flood) and does not address seismic stability. Delta islands or tracts that meet the PL 84-99 criteria may be eligible for USACE funding for levee rehabilitation, island restoration after flooding, and emergency assistance, provided that the reclamation district is accepted into the USACE's program and passes a rigorous initial inspection and periodic follow-up inspections. Eligibility for PL 84-99 was formerly based primarily on levee geometry with minimum freeboard and maximum steepness of slopes. USACE's periodic inspection program incorporates other elements into eligibility, including presence of structure encroachments, vegetation, rodent control programs, and more. The PL 84-99 cross section is roughly equivalent to that proposed in Bulletin 192-82.

  The CALFED Record of Decision set a goal of improving Delta levees to meet the PL 84-99 criteria, as does the DPC Economic Sustainability Plan, but funding has been inadequate to attain this objective. Five Delta reclamation districts, protecting about 3 percent of the legal Delta's land behind about 41 miles of levees, meet or exceed the Delta-specific PL 84-99 criteria, and 24 more districts are more than half-way to improving levees to this standard (Arcadis 2016a; Arcadis 2016b)[1].

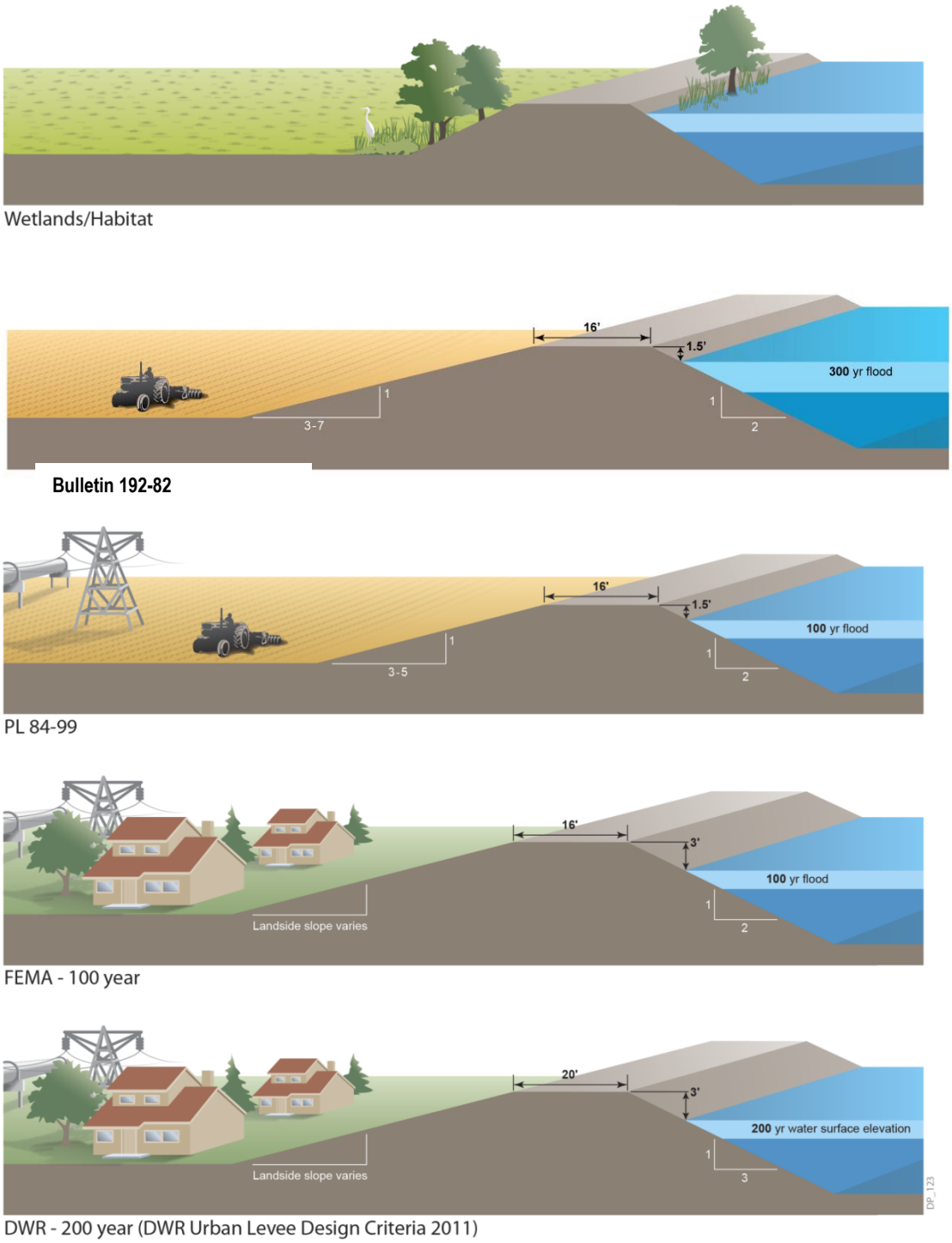
- Suisun Marsh. Guidelines for levees in Suisun Marsh are established in the 1980 *Suisun Marsh Local Plan of Protection*, and are approved by the San Francisco Bay Conservation and Development Commission. The crowns of exterior levees are to be 2 feet above expected high water levels. Where wave action is expected, the freeboard must be at least 3 feet. The more recent *Suisun Marsh Plan* (U.S. Bureau of Reclamation 2012) also proposes habitat levees -- low, wide, gently sloping vegetated levees, which may be overtopped during storm surges with nominal eroding or destabilizing. Habitat levees would include benches or berms that provide wind- and wave-action protection as well as opportunities for high marsh/upland transition habitat.

[1] The 2013 Delta Plan reported that 25 reclamation districts had levees improved to the PL 84-99 criteria according to a report by DWR. That report was based only on the PL 84-99 criteria for freeboard above the base flood elevation, but did not account for the backslope required by the Delta-specific PL 84-99 criteria.

From 1987 until 2014, levee upgrades often sought improvement to meet the Federal Emergency Management Program's Delta hazard mitigation plan (HMP), as a step towards the PL 84-99 or Bulletin 192-82 standards. Good progress was made, with more than half of Delta reclamation districts meeting the HMP criteria (CALFED Bay-Delta Program 2000; Delta Stewardship Council 2013).

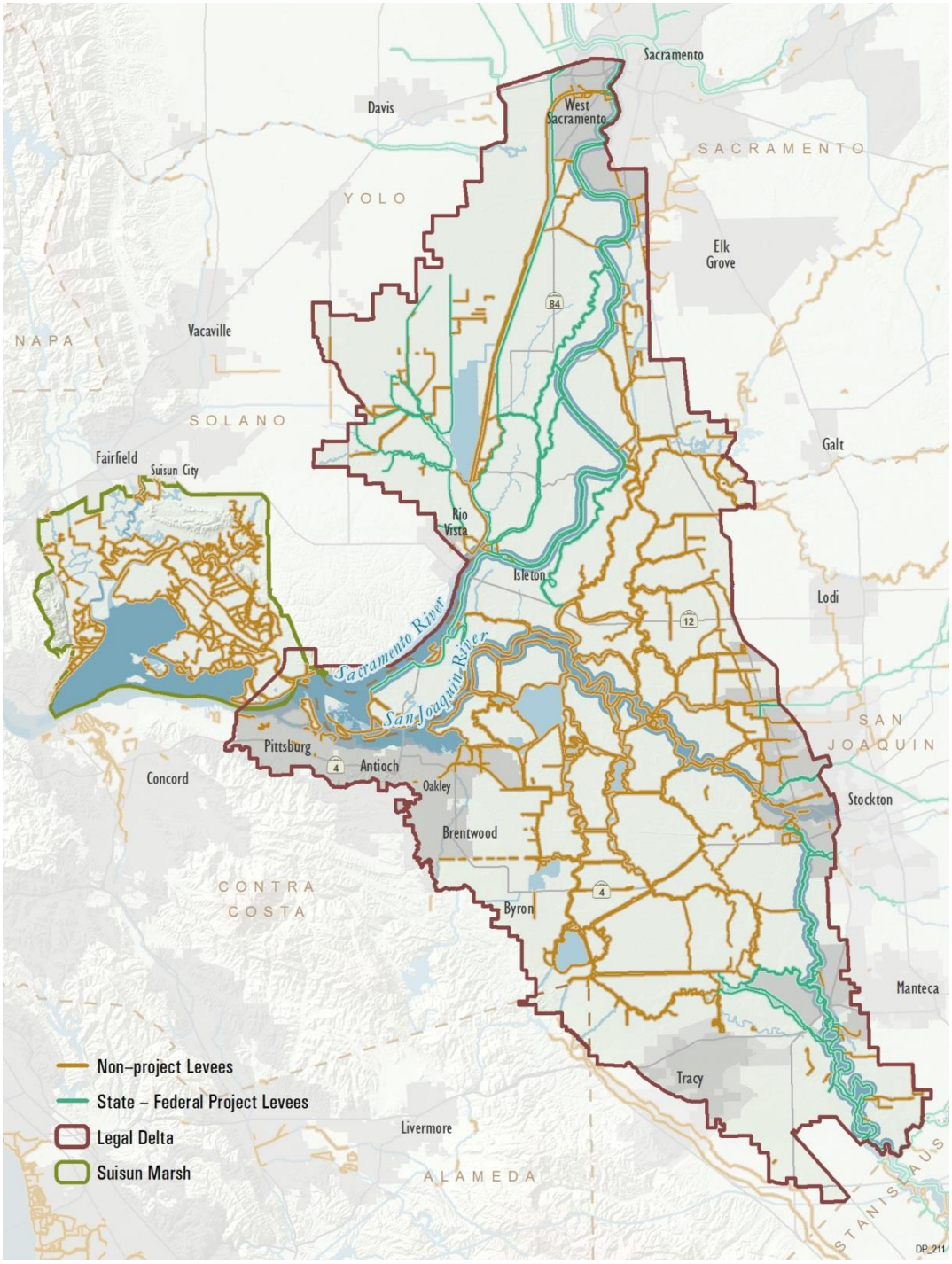
No State standards currently address design criteria for flood protection of the state highways and interstate highways that traverse the Delta. Federal standards require that interstate highways must be protected from 50-year flood events to qualify for Federal Highway Administration funds (23 Code of Federal Regulations 650.115). The levee investment priorities of this chapter applied this Federal Highway Administration standard to identify acceptable risks of flooding to the Delta's interstates and State highways 160, 4, and 12. Because most roads in the Delta were constructed before these standards were developed, they do not meet the standards. For example, sections of State Route 12 are 10 feet or more below sea level. A flood on the islands this highway traverses could interrupt transportation and trade, and put motorists at risk.

Levee Guidance



Source: Adapted from Delta Vision Blue Ribbon Task Force 2008 and DWR 2011b (update from 2013 Delta Plan - added Bulletin 192 and deleted HMP)

Figure 7-4



LEVEES AND ECOSYSTEM FUNCTION

Historically, most discussion of levees has emphasized reducing flood risks to life and property.

Discussion has also occurred on how to more effectively accommodate ecosystem function with the current levee system, highlighting the following issues (Healey and Mount 2007):

- Current levees tend to be narrow, with steep waterside slopes that provide little upland habitat value.
- Setback levees may provide habitat value and increased levee integrity.
- Levees can be used to promote specific habitat types (such as waterfowl habitat) by ensuring that some areas of freshwater marsh are sustained.
- Where lands are not heavily subsided, levees can allow for multiple land uses including habitat management and wildlife-friendly agriculture.
- Allowing levees to fail on deeply subsided islands would not generate any obvious ecological benefits.
- Subsidence reversal on deeply subsided islands would rely on levees to appropriately manage water levels during tule growth.

Habitat and ecosystem values and functions can provide multiple benefits, and must be considered in flood management planning and actions. For example, the CVFPP includes a conservation framework that outlines how environmental elements can be integrated into flood management (DWR 2016a). Setting levees back from the riverbank can expand flood conveyance capacity and reduce flood risk while providing ecosystem restoration and recreational opportunities (USACE 2002). Setback levees also allow opportunities for construction of an improved levee foundation and section using modern design and construction practices, thereby reducing risk of failure. Integrating fish-and wildlife-friendly channel margin treatments into levee improvements can also help (Davenport, Austin, Duryea, Huang, and Livsey 2016).

As management efforts in the Delta proceed, it will be important to consider ecosystem functions and their interactions with the levee system, as discussed in Chapter 4. An example where these interactions are already being debated is the USACE's current policy requiring removal of vegetation from levees. Scientific support for and against this policy is mixed. Concerns with maintaining woody vegetation on levees include difficulties with inspection and flood fighting, potential for root holes, and trees toppling from erosion. Other evidence, however, suggests that woody shrubs and small trees on levees enhance levee structural integrity while providing environmental benefits. A study on a channel levee along the Sacramento River concluded that roots reinforced the levee soil and increased shear resistance by providing increased stability against slope failures (Shields and Gray 1992). In either case, the widespread removal of vegetation from Delta levees could have significant adverse environmental impacts that are not well understood.

RECREATION

The Delta's levees line its greatest recreation asset – the rivers and sloughs that attract boaters, anglers, nature lovers, and other visitors. In appropriate locations, publicly

owned levees and their crown roads can provide access for bank fishing, walking, or bicycling. Private waterside resorts also provide recreation on sites adjoining Delta levees. Where levees adjoin busy highways or farmland or on private levees, and where no entity is responsible for managing recreational use, access may create conflicts that cannot be effectively mitigated. The Delta Plan's chapter 5 calls for considering recreation and access opportunities when levee investment decisions are made.

FLOODPLAINS AND CHANNELS

Floodplains and channels that provide the capacity to carry and store flood flows are critical for managing flood risks, and for overall Delta water management and ecosystem integrity. Projects planned for Yolo Bypass and Paradise Cut are examples of improvements that could add capacity to convey flood flows and help manage flood risks. The CVFPB and FEMA both play roles in designating floodways and floodplains to accommodate flood flows.

The CVFPB regulates encroachment in floodplains by designating floodways in the Sacramento River and San Joaquin River drainages, including the Delta (Water Code section 8609). A "designated floodway" is the channel of the stream and that portion of the adjoining floodplain, as shown on Figure 7-5, reasonably required to provide for the passage of a specified flood. It may also be the floodway between existing levees as determined by the CVFPB.

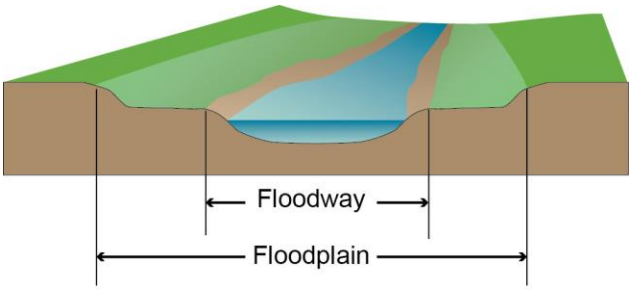
The CVFPB regulates encroachments within designated floodways and regulated streams through its permitting authority. The encroachment permit process applies to all projects, existing and proposed (including habitat restoration projects), within State/federal flood control project levees, designated floodways, bypasses, and regulated streams (CCR, Title 23, Division 1). The CVFPB should be consulted prior to the consideration of any projects that may be in a designated floodway in the Delta. Appendix L includes a map of the CVFPB's jurisdictional areas in the Delta.

Additionally, under the National Flood Insurance Program, FEMA maps floodplains that have a 1 percent chance of flooding in any year (a 100-year flood). FEMA works with participating communities to regulate development within these floodplains according to federal regulations. No new construction, substantial improvements, or other development (including fill) may be permitted within specified flood zones on the community's Flood Insurance Rate Map unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood more than 1 foot at any point within the community.

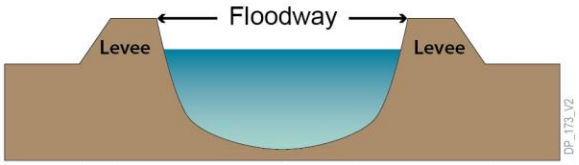
In some flood channels and bypasses, dredging may have benefits because it increases channel capacity and also provides material that can be used for levee maintenance and other flood risk management activities. Because some portions of the Delta are within a tidal pool and other areas are riverine, the efficacy of dredging must be addressed on a site-specific basis and cannot simply be considered useful on a Delta-wide basis.

The benefits and impacts of dredging Delta channels are being investigated by a consortium of federal and State agencies, including U.S. Environmental Protection Agency, USACE, DWR, and the Regional Water Quality Control Boards, under the Delta Dredged Sediment Long-Term Management Strategy (LTMS) Program. The LTMS is designed to improve operational efficiency and coordination of the collective and individual agency decision-making responsibilities resulting in approved dredging and dredged material management actions in the Delta. Approved dredging and dredged material management actions will take place in a manner that protects and enhances Delta water quality, identifies appropriate opportunities for the beneficial reuse of Delta sediments for levee rehabilitation and ecosystem restoration, and establishes safe disposal for materials that cannot be reused (USACE 2007).

Conceptual Diagrams of Floodways



Conceptual Diagram of a Floodway within a Floodplain



Conceptual Diagram of Floodway within a Leveed Channel

Figure 7-5 The floodway is the channel of the stream and that portion of the adjoining floodplain reasonably required to provide for the passage of a specified flood; it is also the floodway between existing levees as determined by the CVFPB or the Legislature.

Source: FEMA 2006

Delta Flood Management Facilities

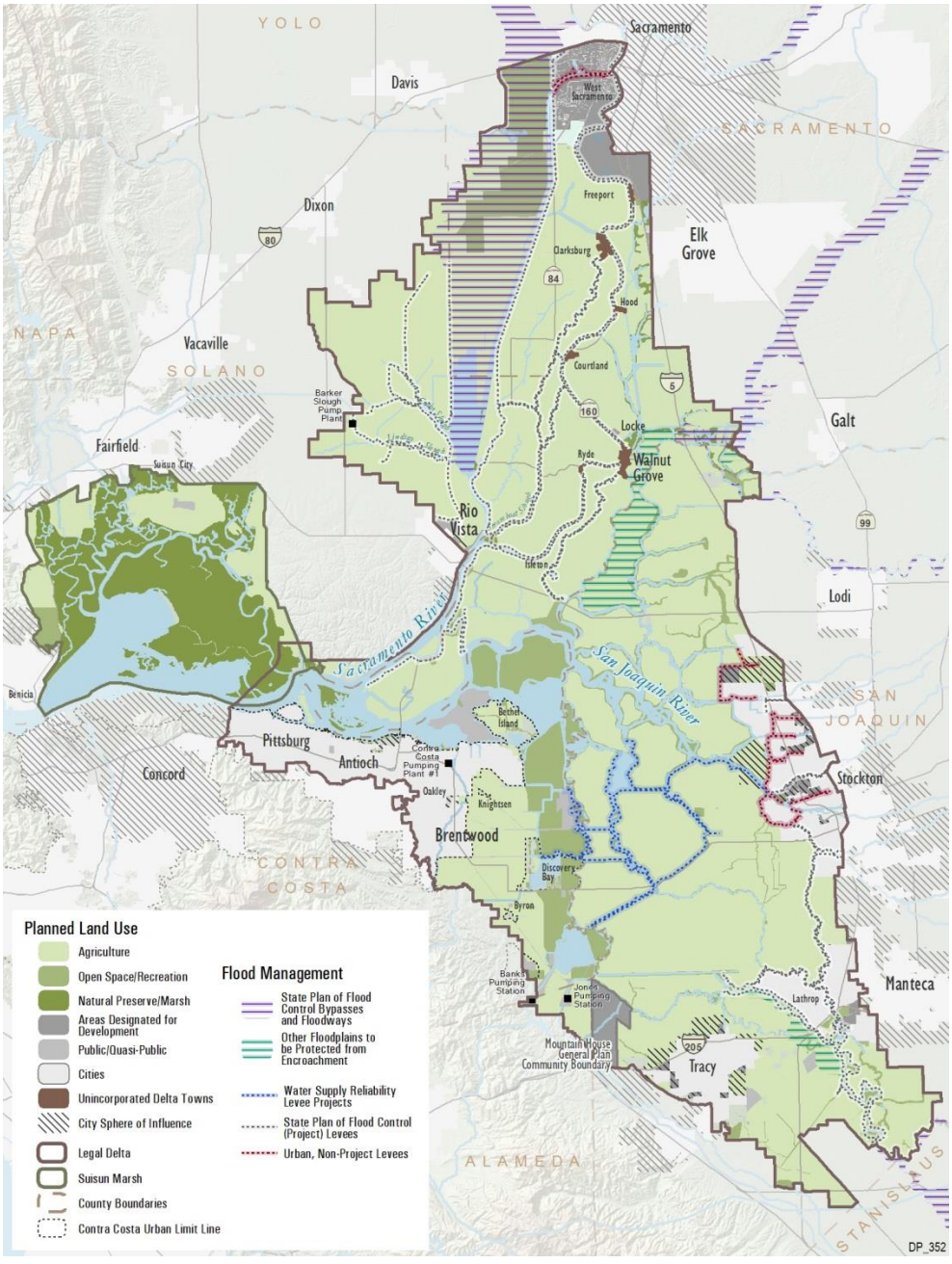


Figure 7-6 The map shows land uses designated by city and county general plans. Within cities' spheres of influences, the map shows land use designations proposed in city general plans, where available. In cases where cities have not proposed land uses within their spheres of influence, the map shows land uses designated by county general plans.

Sources: City of Benicia 2003, Contra Costa County 2008, Contra Costa County 2010, DWR 2011b, DWR 2011c, DWR 2011d, City of Fairfield

2008, Jones & Stokes 2007, City of Lathrop 2012, City of Manteca 2012, Mountain House Community Services District 2008, City of Rio Vista 2001, SACOG 2009, City of Sacramento 2008, Sacramento County 2011, Sacramento County 2012, Sacramento County 2013, San Joaquin County 2008a, San Joaquin County 2008b, Solano County 2008a, Solano County 2008b, South Delta Levee Protection and Channel Maintenance Authority 2011, City of Stockton 2011a, City of Stockton 2011b, City of Suisun City 2011, City of Tracy 2011a, City of Tracy 2011b, City of West Sacramento 2010, Yolo County 2010a, Yolo County 2010b.

INVESTMENT IN REDUCING RISK

Maintaining the Delta's levees and improving them to reduce risk to desired levels will cost billions of dollars. State-subsidized expenditures to maintain rural Delta levees, including local matching funds, averaged $11.6 million annually between FY 2010 to FY 2014. More is spent by State and local agencies to maintain project levees. Costs to improve Delta levees towards desired criteria total about $3 billion: $1.77 billion for urban levees, according to estimates from the Central Valley Flood Protection Plan regional flood management plans, and $1.26 billion, adjusted for inflation, for rural levees (URS Corporation/Jack R. Benjamin & Associates 2011).

Because the Delta's levees reduce risk to residents; agricultural land; water supplies; and energy, communications, and transportation facilities, the State has invested considerable funding to maintain and improve them over several decades through various legislative actions. For rural non-project levees, two State programs provide matching funds to maintain and improve Delta levees. The principal State programs are:

- DWR's Delta Levees Maintenance Subventions Program provides technical and financial assistance to local levee maintaining agencies in the Delta for the maintenance and rehabilitation of Delta levees. It pays up to 75 percent of levee maintenance and improvement costs after a minimum cost threshold has been paid by that district. In practice most recent funding is used to subsidize maintenance, with only modest amounts disbursed for major levee rehabilitation. While the Subventions Program is primarily for non-project levees, project levees qualify if more than 50 percent of the island acreage is within the Delta primary zone. Funding assistance provided by the subventions program is governed by guidelines developed by DWR and adopted by the CVFPB. The subventions program does not fund levee maintenance or improvement in Suisun Marsh.

- DWR's Delta Levees Special Flood Control Projects Program provides financial assistance to local levee maintaining agencies to improve or rehabilitate levees in the Delta, portions of Suisun Marsh (approximately 12 miles of levees on islands bordering Suisun Bay from Van Sickle Island westerly to Montezuma Slough) as well as the town of Thornton (Water Code section 12311). It can fund up to 100 percent of project costs.

An estimated $530 million of State taxpayer money has been spent by DWR on Delta levee maintenance and improvements through the subventions and special projects programs since the 1970s. No federal funds are available for these non-project levees.

Outside of the primary zone, almost all Delta levees are maintained by local levee maintaining agencies without State assistance.

Because the Delta's project levees are authorized as part of the federal flood control project, they are eligible for federal funding for improvements and significant repairs. The CVFPB serves as the nonfederal partner to USACE for the Delta's project levees. The federal government pays between 50 and 75 percent of the total costs of flood control projects authorized by Congress, with the non-federal costs typically shared by State (70 percent) and local entities (30 percent) (Water Code 44 section 12310-12318). The cost sharing ratio varies with the kind of benefits provided. For example, federal cost-share for ecosystem restoration projects can be as much as 65 percent in urban flood risk reduction projects. Water supply, recreation, and other benefits included in flood risk reduction projects can further modify federal cost sharing. The State share of nonfederal costs also depends on the mix of benefits. State funds are distributed through several DWR programs, including its Early Implementation Program, Local Levee Assistance Program, Urban Flood Risk Reduction (UFRR) Program, and Small Communities Flood Risk Reduction Program. $613.3 million has been committed through DWR's Early Implementation Program to improve levees that protect urban and urbanizing areas in the Delta.

The State programs that support Delta levee maintenance and improvement have grown and adjusted incrementally over the years, reflecting new needs and institutions. DWR plays the prominent role. The CVFPB approves guidelines for the Delta Levees Maintenance Subventions Program (Water Code sections 12984 and 12991). The California Water Commission is authorized to approve lists of projects that are priorities for the Special Projects Program (Water Code section 12313(b)). The Department of Fish and Wildlife guides mitigation impacts to fish and wildlife and improvement of their habitats (Water Code sections 12314 and12987(c)). The Natural Resources Agency maintains a recreation plan to be considered in maintenance and improvement plans funded under subventions program (Water Code section12987(e) and is responsible for supervising implementation of the special projects program (Water Code section 12306.5). Simplifying these responsibilities in fewer agencies could both improve oversight and reduce the complexity of interagency coordination.

Prioritizing State Investment in Levees

The Delta Reform Act requires that the Delta Plan attempt to reduce risk to people, property and State interests in the Delta by promoting strategic levee investments and recommending priorities for State investments in the Delta's project and non-project levees (Water Code sections 85305(a) and 85306). Priorities are needed because the funds needed to complete desired levee improvements significantly exceed the funds currently available. History provides little reason to expect that all the funds needed will

soon be provided. Even if more funds were provided, projects providing greater benefits ought to proceed before those with fewer benefits. Given the uncertainty over the amount and availability of future Delta levee program funding, the most prudent approach is to prioritize those that reduce the most significant risks, provide the most benefits and avoid the costliest consequences. Prioritizing investment ensures that limited public funds are expended first for improvements that are most critical to protecting lives, property, and State interests. These priorities, in combination with the Delta Reform Act directive that State agencies act consistently with the Delta Plan and the requirement that reimbursements for major rehabilitation of levees through the Delta Levees Maintenance Subventions Program conform to the Delta Plan (Water Code section 12986), will ensure that State spending on Delta levees reflects these priorities in the future. The Delta Reform Act provides that activities of the Council in determining priorities for State levee investments in Delta levees do not increase the State's liability for flood protection in the Delta or its watershed (Water Code section 85032(j)).

This 2013 Delta Plan envisioned that State funds for flood management would be focused at State interests but that some of that activity would protect local interests as well. The Plan outlined a process to prioritize State investments in levee operation, maintenance, and improvements in the Delta. The Council, following a workshop with flood risk management experts and extensive agency and public comment, adopted a set of principles to provide further guidance for priority setting (Delta Stewardship Council. 2015). Principles relevant to prioritization of levee investments include:

1. The goals of State law and the Delta Plan—and, therefore, the Delta Levee Investment Strategy—are to better protect life, property, and the State's coequal goals for the Delta.
2. State funding should not assist further urbanization of flood-prone Delta land.
3. Expenditures should reduce risk. Reducing the probability of flood damage, for example, by improving levees or creating floodways, and lowering the consequences of flooding with actions like evacuation planning or floodproofing are both important.
4. State flood management investment to protect urban areas is the first priority.
5. Water conveyance and diversion infrastructure is a high priority.
6. State funds must enhance the ecosystem even if projects cost more to the State and to reclamation districts. A programmatic approach that locates ecosystem enhancements where they provide high benefits is preferable.
7. Consider systemwide needs. Specific recommendations of the Delta Plan and the State Plan of Flood Control should be considered. These include the proposed Paradise Cut Bypass recommended in the Delta Plan, and other specified non-project levees.
8. Impacts to the Delta's unique values should be taken into account. These include the Delta's farmlands, historic communities, and natural and cultural resources.
9. State investments in the Delta's flood management system must consider post-flood recovery responses by local, state, and federal agencies and the efficacy and likelihood of financial assistance after flood damage.

10. Owners of non-project levees seeking State funding have the burden to prove that they protect many people and/or assets or help achieve the coequal goals.

This guidance was applied, following an independent science review (Mitchell, Asselman, Bolte, Cutter, McCann, Michelsen, and Rose 2015), to develop a method for assessing potential levee investment priorities in this plan amendment (Arcadis 2016b). The fragility of the Delta's levees to threats from flooding, earthquakes, and sea level rise was carefully evaluated, and the population and property the levees protect were inventoried, using census data, land use maps, assessment information, and other sources. Metrics were developed to weigh the State interests that the Council determined investments should safeguard: water conveyance and diversion infrastructure and the Delta ecosystem. Information about transportation and utility infrastructure and the Delta's unique values including farmland and legacy communities was also gathered, so that risks to these assets could be considered. This information, totaling 1.5 million data points, was assembled into a database that is analyzed by a computer-assisted decision support tool to aid in evaluating alternative priorities. Islands and tracts where levee improvements further multiple objectives, such as protecting both water supply and the Delta ecosystem, were preferred to projects that advance only a single interest. Also considered in setting priorities were information about system wide needs, including recommendations of the Delta Plan, the Central Valley Flood Protection Plan and other proposals for the State Plan of Flood Control, and the California EcoRestore initiative. Advice from the Central Valley Flood Protection Board, DWR, other flood agencies, and Delta stakeholders has also been considered.

Gathering and evaluating the information used to recommend investment priorities has been a considerable and controversial effort. Despite the limitations of the data available, the effort has been more thorough, comprehensive, and transparent than prior studies. As data is updated and levee conditions change with improvements, the Council intends to maintain and improve its data base and decision support tool, both to track the performance of State levee investments and to support periodic reviews of the Delta Plan.

Continue and Improve the Delta Levees Maintenance Subventions Program

Confirmation that continued maintenance of Delta's levees remains important is one result of this evaluation. This maintenance, including ongoing State financial support through the Delta Levees Maintenance Subventions Program, should continue. It reduces risks to lives, property and State interests and contributes to preservation of the Delta's unique agricultural, natural, and cultural resources. This maintenance of the Delta levee network also reduces the risk that failure of one island's levees could expose adjoining islands to increased wind waves or seepage.

Prioritize State Levee Investments

Investments that improve Delta levees towards applicable standards and guidelines are critical to protecting lives, property, and State interests. Priorities for these

improvements are recommended in Figure 7-X and Table 7-Y. The very highest priorities are improvements to levees protecting urban and urbanizing areas of Sacramento, West Sacramento, and metropolitan Stockton, where the most lives and property are at risk. Another very high priority is improving levees on Sherman, Twitchell, Brannan-Andrus, Upper Andrus, and Grand islands along the Highway 160 corridor, where the quality of water supplies, restored marshes, transportation routes, the communities of Isleton, Ryde, and Walnut Grove, and farmland are at risk. Further north along Highway 160 levee improvement in the rural southern portion of Maintenance Area 9 is ranked as a very high priority because of risks to life, property including the communities of Freeport and Hood, and Stone Lakes National Wildlife Refuge. Bethel and Jersey Islands rank as very high priorities because both islands are important to the quality of water supplies, many people and much property are at risk on Bethel Island, and Jersey Island holds important wildlife habitat. Improving Byron Tract's levees is a very high priority because of risks to both lives and water supply infrastructure. At Dutch Slough and the McCormack Williamson Tract, the very high priority is retiring outmoded levees by restoring the sites to marsh, contributing to the net improvement of aquatic habitats required of the Delta Levees Special Flood Control Projects Program (Water Code section 12311).

Thirty-three other islands and tracts are identified as high priorities for levee improvements. On many of these, water supplies or ecosystems are at risk, but benefits to multiple interests are not significant. Improvements on other high priority islands and tracts may reduce risks to multiple values, but benefits are lower than on very high priority areas. Levees at the Yolo Bypass (including levees bordering the bypass in Reclamation Districts 2068 and 2098), the proposed Paradise Cut Bypass, and levees protecting interstates and State highways 160, 4, and 12 are also identified as high priorities to indicate their improvement will be important when feasibility studies or CalTrans' climate change vulnerability studies indicate upgrades are the best alternative.

Stockpiling material for emergency repairs of levees on the water export corridors along Middle and Old Rivers toward the pumps of the State Water Project and Central Valley Project or at sites serving local reclamation districts can complement these levee improvements. No foreseeable amount of improvement will make the Delta's levees invulnerable to failures in large floods or earthquakes. Placing levee repair materials where they are readily available to repair damage is prudent preparation for disasters that may come. In the unfortunate event that a levee failure occurs, the coequal goals of providing a more reliable water supply and protecting, restoring, and enhancing the Delta ecosystem should be evaluated as part of the post-disaster response process.

Every levee is important to those whose safety or property is protected. The islands and tracts of the legal Delta that are listed as "other priorities" are not unimportant. State funds for improving their levees ought to be considered after worthy projects on very high priority and high priority islands are funded. Some of these islands and tracts hold valuable property or have important water supply or ecosystem values, but face lower risks of failure, often because of previous State-funded levee improvements. Others

may have levees with high probability of failure, but have few residents, less valuable property, or lower water supply or ecosystem values. Suisun Marsh levees, except for those bordering Suisun Bay from Van Sickle Island westerly to Montezuma Slough, are ineligible for State funds for levee improvement (Water Code section 12311), a restriction that should be maintained.

In awarding State funds to improve these levees, DWR may vary from these priorities when necessary to protect lives, property, or the State's interests in water supply reliability, the Delta ecosystem, considering the Delta's unique agricultural, natural, cultural, or recreational values. The reasons for any variations should be explained.

UPDATE FUNDING STRATEGIES

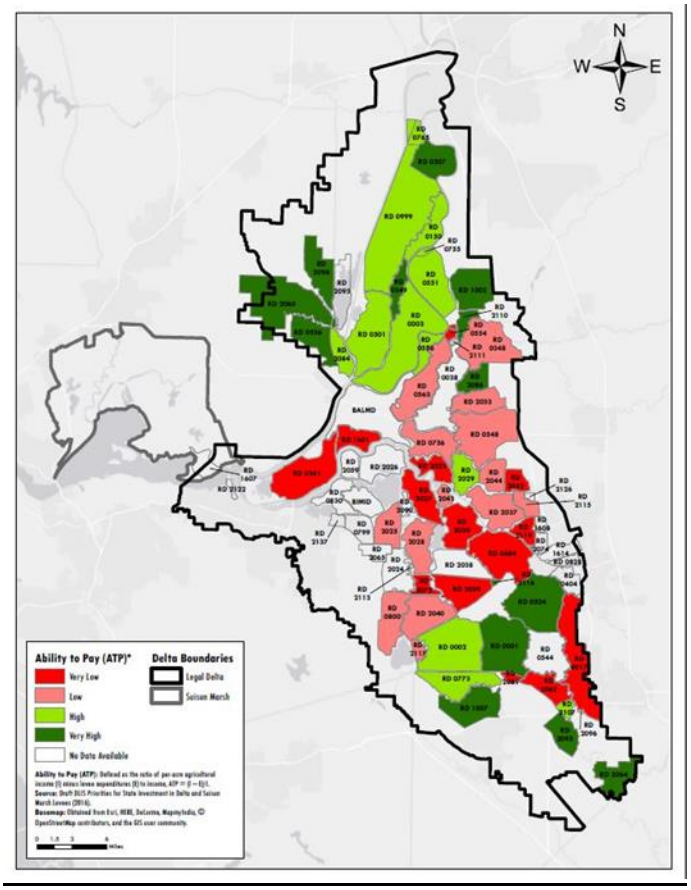
"Who pays what" is a key to financing all public works. The Delta Plan endorses the principles that "beneficiaries pay" and "stressors pay." The Council's levees investment strategy principles include:

1. The Delta Levee Investment Strategy should be based on the Delta Plan principle that beneficiaries pay. The State share of levee improvements should reflect the State interests at stake. Levee maintenance is primarily the responsibility of local reclamation districts and their property owners, not the State. The State should also take into account the ability to pay of local agencies.
2. The State should create a Delta Flood Risk Management Assessment District with the authority to charge all beneficiaries.

In practice, almost all funds for most Delta levees' maintenance and improvement have come from two sources – landowners through assessments on lands or other property protected by the levee network, and the State's general fund, both through direct appropriation and through the repayment of general obligation bonds. Annual funding for levee improvements and maintenance is constrained currently by annual appropriations of State funds, statewide bond measures, and by affordability and budgeting at the local level, where jurisdictions, whether urbanized or rural, face budgetary constraints and competition for tax dollars from a multitude of public needs.

Although the State contributes the majority of funds for maintaining and improving nonproject Delta levees, the concept of shared responsibility with local landowners is key to the Delta's levees long term viability. The continued participation and financial support of local reclamation districts is essential. As noted in the Delta Reform Act's Section 85003(b), "Delta property ownership developed pursuant to the federal Swamp Land Act of 1850, and State legislation enacted in 1861, and as a result of the construction of levees to keep previously seasonal wetlands dry throughout the year. That property ownership, and the exercise of associated rights, continue to depend on the landowners' maintenance of those nonproject levees and do not include any right to state funding of levee maintenance or repair." Local cost shares are paid from property assessments. In the rural Delta, assessments, which also cover reclamation districts' drainage expenses, often average $10 to $40 per acre annually, with higher

assessments in districts that are matching significant State funds for levee improvement (Delta Stewardship Council 2015). Local agencies have varying ability to pay, influenced by the value of land that can be assessed and the desires of their voters, who are usually property owners. In the rural Delta, where the productivity and use of agricultural land strongly influences land values, districts' ability to pay varies widely (Arcadis 2017).



Most recent State funds have come from general obligation bonds, such as those, authorized by Proposition 1E for flood risk reduction. The reliance on State bonds to fund 75 to 100 percent of levee improvement and maintenance costs not only limits the amount of annual funding available but is an uncertain source of future funding for these very costly long term capital and maintenance needs. Another drawback of relying primarily on statewide bond measures to fund Delta levee improvements and maintenance is that the Delta's needs must compete with other regions, increasing the uncertainty of bond-funded appropriations.

Prior to the availability of bond funds, the subventions program was supported with modest levels of general funds. The reliance on general fund reflects in part a proper allocation to the State of costs to protect broad-based public benefits such as protecting public safety, enhancing fish and wildlife habitat or safeguarding water quality. Without another way to collect funds from water users, highway and railroad users, or utility

customers, the general fund may also approximate these broad-based classes of beneficiaries.

The State's cost share for levee maintenance and improvement varies among programs. The Delta Levees Maintenance Subventions Program pays up to 75 percent of local costs, above $1,000 per levee mile, to maintain and rehabilitate nonproject and some project levees. The $1,000 per levee mile deductible, last updated in 1981, is an approach to State-local cost sharing. This deductible equates to approximately $3 per acre for reclamation districts within the Delta. If the deductible were updated for inflation since 1981, it would be $2250 to $2500 per mile, depending on the index used to measure rising costs or crop prices. At the upper limit of $2500 per mile, this would equate to approximately $7 per acre for Delta reclamation districts Studies of a local agencies' ability to pay are supposed to inform cost-sharing between local districts and the State, but in practice are seldom completed or applied.

Most project levees are maintained without State support by local agencies or State-imposed maintenance areas funded by local landowners.

Improvement of nonproject levees is usually funded through the Delta Levee Special Projects Flood Control Program, although occasionally the Delta Levees Maintenance Subventions Program funds rehabilitation projects that improve levees. The Special Flood Control Projects Program may pay up to 100 percent of improvement costs, subject to cost sharing agreements it may enter into with the beneficiaries or owners of infrastructure, such as utilities or highways that benefit from the improvement. The USACE's conclusion that there is no federal interest in improving non-project Delta levees removes the CALFED Bay-Delta Program's expectation that the federal government might pay up to half the cost of these levees' improvement. Improvements to project levees usually include at least a 50 percent federal cost share, with greater federal support when improvements provide ecosystem restoration or other benefits.

To widen other levee beneficiaries' participation in funding levee maintenance and improvement, the 2013 Delta Plan and the DPC's Economic Sustainability Plan proposed creating a regional agency with fee assessment authority to assist with the financing, planning, and implementation of Delta flood risk reduction activities. It was hoped that this alternative funding mechanism could provide a more stable, long-term approach to funding in which local participation by all beneficiaries of flood risk management is more broadly incorporated. Phase 1 of the DPC efforts, however, suggests that such a district is infeasible because it cannot capture revenue from all beneficiaries of Delta levees and the significant legal and political hurdles of creating an assessment district crossing so many jurisdictional boundaries. Instead, the DPC is exploring other approaches to involving beneficiaries in paying for levee improvements (M.Cubed 2016). Phase 1 of the DPC effort suggests that the most feasible portfolio of finance mechanisms is one that could generate revenue to pay for levee maintenance, repair, rehabilitation and improvements, including new fees that would bring in revenue from beneficiaries that do not currently pay for Delta levees in proportion to the benefits they receive. Candidates include contributions from the State Water Project or Central Valley Project for improvements protecting the conveyance of water through the Delta

for export, a water use fee linked to improvement of levees protecting water quality, fees on energy or telecommunication utilities with infrastructure protected by levees, contributions from CalTrans as it implements strategies to reduce its highways' vulnerability, reactivation of the Sacramento-San Joaquin Drainage District as proposed in the draft Central Valley Flood Protection Plan, or regional assessments to respond to sea level rise. This potential portfolio of finance mechanisms may help move toward a levee funding system based on the "beneficiary pays" principle, increasing the funds available to pay for levee maintenance or priority levee improvements. These approaches should be further investigated by the DPC in the next phase of work and pursued, if viable, along with action by the Public Utilities Commission recommended in the Delta Plan to promote cost-sharing of levee improvements by investor owned utilities.

PLANNING FOR FLOODPLAIN LAND USE

The most important step in reducing risk to people in the Delta is to stop putting more people at risk behind levees that do not meet minimum modern standards for flood protection. Actions that increase the demand for higher public spending on flood risk reduction and exacerbate flood risk (for example, urbanizing floodprone areas) should be discouraged (Galloway, et. al. 2007).

The DPC Land Use and Resource Management Plan for the Primary Zone of the Delta also includes important policies to limit development in floodprone areas of the Primary Zone:

> *Local governments shall carefully and prudently carry out their responsibilities to regulate new construction within flood hazard areas to protect public health, safety, and welfare. These responsibilities shall be carried out consistent with applicable regulations concerning the Delta, as well as the statutory language contained in the Delta Protection Act of 1992. Increased flood protection shall not result in residential designations or densities beyond those allowed under zoning and general plan designations in place on January 1, 1992, for lands in the Primary Zone. (DPC 2010)*

As noted in Chapter 5, the legacy community of Bethel Island warrants a special note because of its flood hazards. About 2,100 people reside on the island in about 1,300 residences concentrated on the south-central shoreline and four mobile home parks. The island, which is below sea level, is surrounded by approximately 15 miles of levees, limiting the drainage of floodwaters in the event of a levee breach. A single road, Bethel Island Road, links the island to the mainland at the city of Oakley, complicating emergency response or evacuation in the event of flooding. Because developments on Bethel Island are proposed to be served by the Bethel Island Municipal Improvement District or other adjacent public services, the entire island is within the urban limit line adopted by Contra Costa voters in 2006. The high flood risks on the island and the restricted evacuation opportunities, however, indicate the island has greater hazards to lives and property than the Delta's other areas designated for development. For this

reason, it is not excluded from the Delta Plan policy prohibiting new subdivisions unless adequate flood protection is provided. This is consistent with provisions of the Contra Costa County General Plan, which require that development other than a single home on existing parcels await resolution of several issues, including improvement of the community's public services, levees, and emergency evacuation routes.

As described in Chapter 5, urban residential, commercial, and industrial uses should be located in cities, other urban areas, and their spheres of influence, where strong levees can be provided, rather than in rural lands protected only by nonproject levees. Outside of these urban and urbanizing areas and the legacy communities, the Delta Plan prohibits major subdivisions of five or more parcels where 200-year flood protection is not available. In rural areas, any new rural residential subdivisions should anticipate rising sea levels by going beyond FEMA standards to designate home sites that will be above the sea level anticipated in 2100. Recognizing legacy community needs for incidental growth to maintain their unique cultural values, development within community boundaries should continue consistent with existing general plans, and federal and local flood protection laws. Appendix B provides maps of Delta community boundaries. Maintaining most of the Delta in rural, agricultural land use, as described in Chapter 5, complements policies that reduce the number of properties and the population exposed to high flood risks.

Finally, the participation of Delta counties and cities in the National Flood Insurance Program brings with it a requirement that all residential, commercial, agricultural, and industrial buildings comply with FEMA floodproofing standards, including elevating structure ground floors above the 100-year flood elevation. Examples of floodproofing are shown on Figure 7-7

Examples of Floodproofing

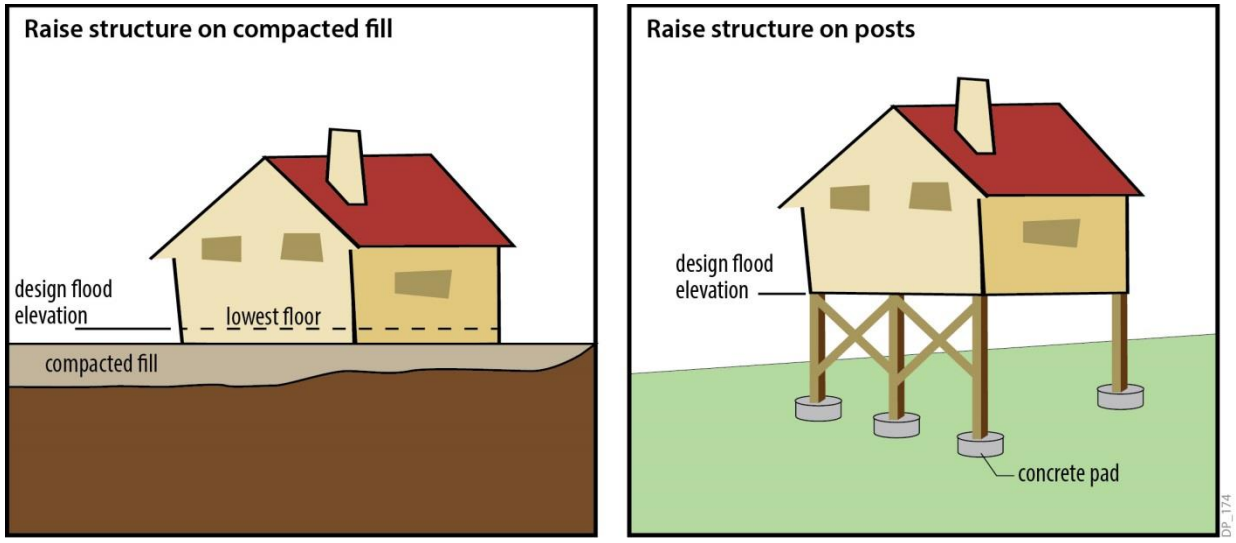


Figure 7-7 Floodproofing in accordance with the National Flood Insurance Program can be achieved through several methods. The illustration on the left shows an example of floodproofing by constructing the lowest floor within a structure above the design flood elevation. The illustration on the right shows floodproofing by raising the bottom of the structure above the design flood elevation.
Source: FEMA 1994; FEMA 2001

FUNDING FOR NON-STRUCTURAL RISK REDUCTION

Flood risks to lives and property can be reduced by investing in emergency evacuation routes, flood proofing, or other actions in addition to levees. In the Delta's unincorporated towns or rural developments, these non-structural risk reduction activities may be preferred when improving levees is not affordable or cost effective. Pursuing these alternatives can be difficult, however, because State funds are primarily available for levee improvements, rather than the full range of risk reduction activities. As the State makes additional funds available for flood risk reduction, providing funds for nonstructural risk reduction as well as levee improvement can give Delta residents more choices about how to reduce flood risks.

EMERGENCY PREPAREDNESS AND RESPONSE

Even with the best-engineered levees, channels, and floodways, a residual risk from flooding will always remain; flood risk can never be eliminated. Although investment in flood protection infrastructure can considerably reduce the likelihood of a catastrophic levee failure, failures are inevitable and will require well-coordinated and carefully developed emergency response efforts. A 200-year flood or earthquake could badly damage levees at up to 10 to as many as 40 islands (Arcadis 2016b). To reduce response time and optimize effectiveness of response efforts after such a disaster,

emergency plans need to leverage the unique capabilities of each agency with a mission in the Delta. This section provides an overview of the agencies and planning involved in emergency preparedness and response in the Delta.

Responsibilities for preparing for, declaring, and responding to flood emergencies are distributed among local, State, and federal agencies. Federal agencies with authority include USACE and FEMA. In California, State and local responsibilities fall to county offices of emergency services, local reclamation districts, Cal EMA, and DWR. In a Delta flood emergency, the response efforts by local and State emergency management professionals are guided by California's Standardized Emergency Management System (SEMS). SEMS was established by Government Code section 8607(a), and provides for effective management of multiagency and multijurisdictional emergencies in California, including flood emergencies. This system consists of five organizational levels, which are activated as necessary: (1) field response, (2) local government, (3) operational area, (4) regional, and (5) State. These levels are activated stepwise as the events warrant additional response and resources, meaning that each level of emergency responder contacts the next level above them should they deem the emergency beyond their capabilities to control. Federal resources are called upon if State resources are exhausted or additional assistance is needed. SEMS incorporates the functions and principles of the Incident Command System, the Master Mutual Aid Agreement, existing mutual aid systems, the operational area concept, and multiagency or interagency coordination. A detailed discussion of SEMS can be found in Cal EMA SEMS Guidelines (Cal EMA 2009). Local governments must use SEMS to be eligible for funding of their response-related personnel costs under State disaster assistance programs.

At the State level, Cal EMA's *California Emergency Plan* is the current guiding plan for all State emergencies. The California Emergency Plan incorporates and complies with the principles and requirements found in federal and State laws, regulations, and guidelines. Cal EMA typically defers to DWR for emergency management during floods. DWR emergency flood management actions are guided by its 2007 *Interim Flood Emergency Operations Plan*. DWR is in the process of developing its Delta Flood Emergency Preparedness Response and Recovery Program (EPRRP), which will be the overall guiding flood emergency management program for DWR activities for project and nonproject levees in the Delta. The Delta Flood EPRRP consists of three components: (1) the plan for flood emergency preparedness, response, and recovery actions in the Delta; (2) multiagency plan coordination, which coordinates DWR's plan with the plans of other Delta flood response agencies; and (3) response facilities implementation, which includes the development of flood emergency response facilities in the Delta.

At the federal level, USACE has a standing All-Hazards Emergency Response Plan and standing contracts for emergency response work in the Delta region, and is ready to assist the State, as requested through PL 84-99. These existing plans and procedures are considered in DWR's flood emergency operations plans and are a critical part of the Delta Flood EPRRP Plan. FEMA is responsible for coordinating the response of several

federal agencies to a large natural disaster that overwhelms the resources of State and local authorities. The primary duty of FEMA is to ensure services to disaster victims through operational planning and integrated preparedness measures.
To further address emergency preparedness and response issues in the Delta, Water Code section 12994.5 calls for developing and implementing multi-hazard preparedness and response strategies for the Delta. This legislation requires the Office of Emergency Services (CalOES) to establish the Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force. Led by CalOES, the task force consists of representatives from the DPC, DWR, and the five Delta counties. The task force was directed to do the following:

- Make recommendations to CalOES about creating an interagency unified command system organizational framework, in accordance with the guidelines of the National Incident Management System (NIMS) and the Standardized Emergency Management System (SEMS);
- Coordinate development of a draft emergency preparedness and response strategy for the Delta; and
- Develop and conduct all-hazard emergency response exercises and training in the Delta that would test or facilitate implementation of regional coordination protocols.

The recommendations prepared by the task force include identifying potential threats and consequences affecting the Delta, developing a Delta catastrophic flood incident plan to guide integrated emergency response in the Delta, and the preparing a regional mass evacuation plan.

RENEWING FEDERAL ASSURANCES OF ASSISTANCE IN RECOVERING FROM FLOOD DISASTERS

Following a flood disaster, various federal programs can provide disaster assistance. The federal agencies have repeatedly helped fund post-disaster repairs of Delta levees and other public infrastructure, providing aid after floods in 1980,1982,1983,1986, 1997, 2004, and 2006. FEMA's Hazard Mitigation Plan (HMP) criteria must be met to be eligible for its assistance (Delta Stewardship Council Staff 2010b). USACE has specific criteria concerning eligibility for assistance to repair levees under PL 84-99. The Delta HMP agreed to between California agencies and FEMA was intended to reduce risks to the property that Delta levees protect, so that federal aid would be needed less often. The State's investment in Delta levee maintenance and improvement has in part been in fulfillment of its responsibilities under the HMP.

Today, however, California can no longer rely on federal assistance to rebuild Delta levees damaged in floods. Following Hurricane Katrina and other expensive disasters, eligibility requirements for FEMA and USACE post-disaster assistance for levee repairs have been tightened and more rigorously enforced. Most rural Delta project levees were either removed from the Corps' PL 84-99 program or are expected to become ineligible soon. In 2014, the Delta HMP was not renewed, despite the considerable State investment in its implementation. The agreement's termination partly reflected FEMA's

concern that sufficient progress had not been made toward its long-term goal of bringing levees up to the USACE Delta specific PL 84-99 standard and growing realization of the costs that flood disasters nationwide are imposing on the federal government.

Planning for levee improvement and maintenance is difficult without more certainty about the reliability of federal post-disaster recovery programs, including the criteria that could be imposed on reclamation districts seeking whatever federal levee repair assistance may be available. Revising assistance criteria to reflect the Delta's unique setting and its water supply and ecosystem values is an important aspect of seeking renewed federal commitments. Without federal assistance, post-disaster recovery would be difficult and expensive. Landowners alone would be unlikely to repair levees damaged in a disaster on 18 to 23 Delta islands where the cost of repairs is likely to exceed the value of the islands' property (Suddeth, et. al. 2010). Federal assistance in rebuilding these levees could significantly lower landowners' repair costs, increasing the likelihood that damaged islands would be reclaimed. The lack of federal assistance shifts to the State the cost of aiding local agencies in levee repairs, because State law provides that post-disaster levee repair claims not paid by federal agencies may be reimbursed by the State through DWR's Delta Levees Maintenance Subventions Program (Water Code section 12993). As risks grow with rising seas, the importance of FEMA's hazard mitigation assistance will only increase proportionately.

LIABILITY CONCERNS

USACE and other federal agencies are generally afforded some immunity from liability for damages from flood events under the concept of sovereign immunity and provisions of the Flood Control Act of 1928 (33 United States Code section 702c). Congress provided immunity to federal agencies for some but not all tort damages. However, this immunity does not apply to nonfederal agencies.

As the risks of levee failure and corresponding damage increase, California's courts have generally exposed public agencies, and the State specifically, to significant financial liability for flood damages (DWR 2005). The most notable recent court decision on flood liability was the California Court of Appeal decision in *Paterno v. State of California* (2003) (113 Cal. App. 4th 998). The court found the State was liable for damages caused by the failure of a project levee on the Yuba River that the State did not design, build, or even directly maintain. This decision makes it possible that the State will ultimately be held responsible for the structural integrity of much of the federal flood control system in the Delta and Central Valley. The *Paterno v. State of California* decision will ultimately cost State taxpayers approximately $464 million in awarded damages.

In *Arreola v. County of Monterey* (2002) (99 Cal. App. 4th 722), the court held local agencies and the California Department of Transportation (Caltrans) liable for 1995 flood damages to property owners that resulted from a failure to properly maintain levees of the Pajaro River project.

One way to reduce State liability is to expand participation in flood insurance programs. Flood insurance premiums are increasing as Congress reacts to steady program losses from recent flood disasters. High premiums, however, make flood insurance less affordable for many Delta residents. Local government participation in the flood insurance program's community rating system can help lower rates as communities undertake activities that reduce flood risks, like evacuation planning, floodproofing, or buying out repetitively damaged properties.

The California *FloodSAFE Strategic Plan* states, "Local communities are responsible for land use decisions, but generally have not been found liable for failure of the flood protection system. Continued local actions to approve development within floodplains may increase flood risk, even if levees and other flood protection improvements are made. This creates liability issues which the State is concerned about. Legislation passed in 2007 addresses the need to connect land use planning with diligent and factual consideration of flood risks for areas of proposed development" (DWR 2008a).

In 2007, the Legislature amended the Water Code to address local community liability for approving development in floodprone areas. It provides that "a city or county may be required to contribute its fair and reasonable share of the property damage caused by a flood to the extent that the city or county has increased the state's exposure to liability for property damage by unreasonably approving new development in a previously undeveloped area that is protected by a state flood control project" (Water Code sections 8307(a) and (b)).

> *Ultimately, however, it is important to note that the State does not own, operate, control, or maintain nonproject levees, and does not have authority to do so. The Delta levee subventions program grants financial assistance to local reclamation districts for their levees. The State conducts evaluations to make sure subventions program funds have been spent appropriately, but not to ensure the quality of the work or the stability or structural integrity of nonproject levees. Rather, the nonproject levees are the sole responsibility of the reclamation districts, and the State is not liable for damages caused by their failure.*

POLICIES AND RECOMMENDATIONS

These policies and recommendations are based on the Council's core strategies for reducing flood risks in the Delta, which are:

- Continue to prepare for Delta flood emergencies
- Modernize levee information management
- Prioritize investment in Delta levees
- Update flood management funding strategies
- Manage rural floodplains to avoid increased flood risk
- Protect and expand floodways, floodplains, and bypasses
- Renew assurances of federal assistance for post disaster response

- Limit State liability

Reducing flood risks also relies on locating urban development in the Delta's cities where levees are stronger as discussed in Chapter 5, and retaining rural lands for agriculture, so that development in the most floodprone areas is minimized.

Continue to Prepare for Delta Flood Emergencies

To effectively and reliably reduce risks to people, property, and State interests in the Delta and to respond rapidly to flood disasters, a multifaceted strategy of coordinated emergency preparedness, appropriate land use planning, and prioritized investment in flood protection infrastructure is necessary (Water Code sections 85305(a) and 85306). Federal, State, and local governments -- and Californians -- must be prepared for a variety of emergency situations.

The recommendations prepared by the Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force play an important role in planning efforts for the Delta.

Problem Statement

Levee failures and flooding can and will place human life and property in danger, and can have potentially significant implications for the State’s water supply and infrastructure, and the health of the Delta ecosystem. Investments in levee maintenance and improvement can reduce but not eliminate these risks. Appropriate emergency preparedness and response planning and implementation activities need to continue and expand.

Policies

No policies with regulatory effect are included in this section.

Recommendations

RR R1. Implement Emergency Preparedness and Response

The following actions should be taken to promote effective emergency preparedness and response in the Delta:

- Responsible local, State, and federal agencies with emergency response authority should continue to implement the recommendations of the Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force (Water Code section 12994.5). Such actions should support the development of a regional response system for the Delta.
- Materials should be stockpiled in appropriate locations to make post-disaster repairs of breaches in levees along the water supply reliability corridor identified in the Delta Plan’s Figure 7-6, the western islands important to protection of

water quality, and other levees, to complement improvement of levees as provided in RR P1.

- Local levee-maintaining agencies, with assistance from DWR, should develop their own emergency action plans, training, and floodfight material stockpiles.
- State and local agencies, and regulated utilities that own and/or operate infrastructure in the Delta should prepare coordinated emergency response plans to protect the infrastructure from long-term outages resulting from failures of the Delta levees. The emergency procedures should consider methods that also would protect Delta land use and ecosystem.

Modernize Levee Information Management

Problem Statement

Information about levee conditions is held by many parties. Data is not gathered consistently or shared widely or easily, leading to disagreements about maintenance needs and progress towards objectives for risk reduction and levee improvement. Without adequate information, planning is hindered and program performance is difficult to judge (Committee on Integrating Dam and Levee Safety and Community Resilience. 2012)

RR R2. Modernize Levee Information Management

A. Require Adequate Levee Inspections. In order to gather information about Delta levee conditions and maintenance needs, the Central Valley Flood Protection Board should update its guidelines for the Delta Levees Maintenance Subventions Program to require local levee maintaining agencies participating in the program to annually inspect their Delta levees in accordance with DWR's guidelines for Local Agency Project and Nonproject Levee Maintenance Inspection and to file their inspection reports electronically with DWR. Costs of inspections should continue to be reimbursable through the Delta Levees Maintenance Subventions Program.

B. Provide Delta Levee Investment Decision Support. The Delta Stewardship Council should use information from levee inspections reported to DWR and from DWR's annual reports about its levee investments pursuant to this plan's policy regarding levee investment priorities (RR P1) to maintain the decision support tool developed during preparation of this Delta Plan amendment.

Prioritize Investment in Delta Flood Management ~~Investment~~

The Delta Reform Act of 2009 charges the Council to attempt to reduce risks to people, property, and State interests in the Delta (Water Code section 85305) by promoting, in part, strategic investments in Delta levees. The Council is required to recommend in the Delta Plan priorities for investments in levee operation, maintenance, and improvements in the Delta, in consultation with the Central Valley Flood Protection Board (Water Code section 85306). The Council's policy is to reduce flood risk in the Delta with cost-

effective investments that further the coequal goals of California law: “a more reliable water supply for California and protecting, restoring and enhancing the Delta ecosystem”, in a manner that protects and enhances the “unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place” (Public Resources Code section 29702).

Problem Statement

The Delta Reform Act (Water Code section 85306) requires the Delta Plan to recommend priorities for State investments in Delta levees, including project and nonproject levees. Currently, no comprehensive method exists to prioritize State investments in Delta levee operations, maintenance, and improvement projects. Without ~~a~~ a prioritization, the apportionment of public resources into levees may not occur in a manner that reflects the risks to lives, property, and State interests.

Policies

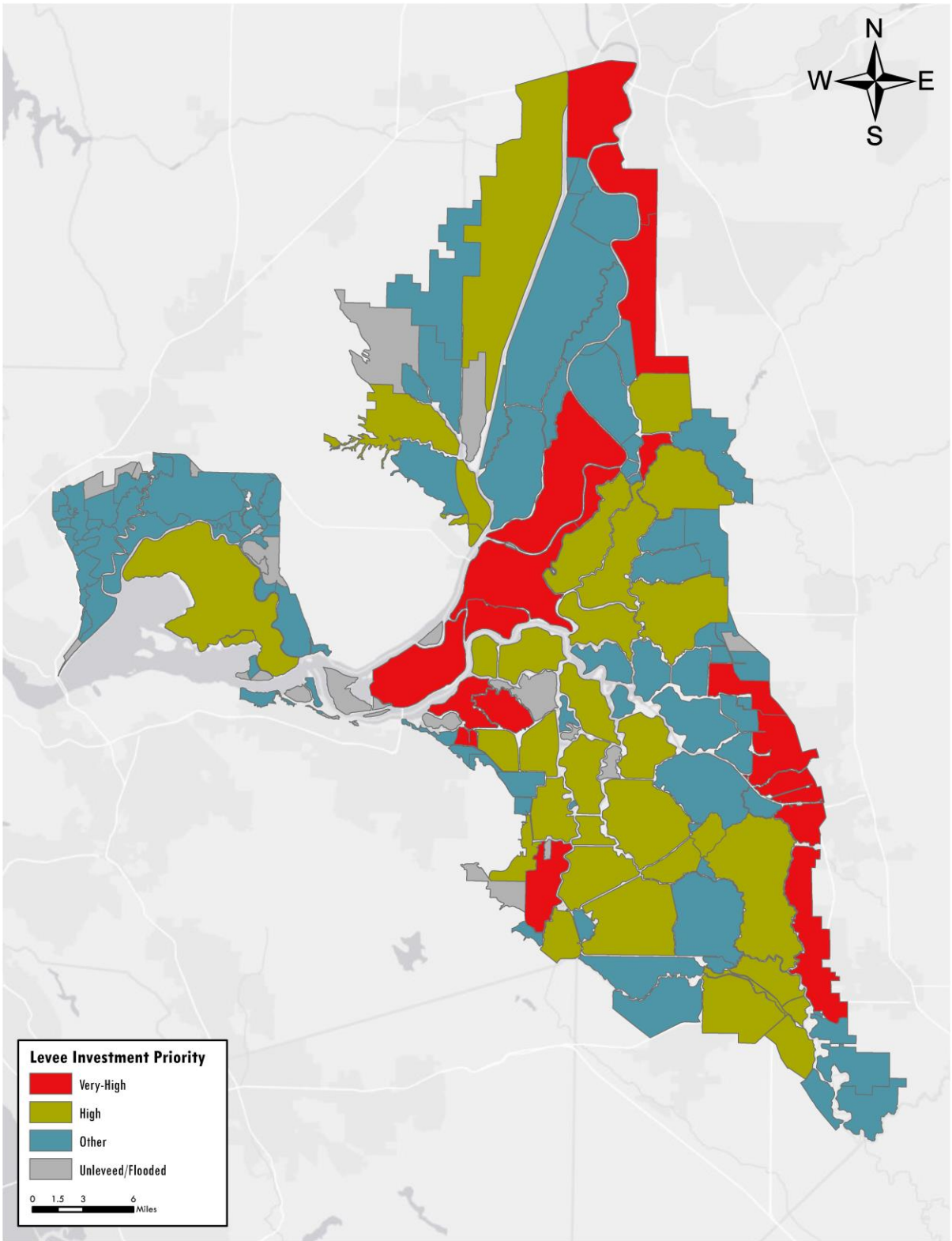
RR P1. Prioritization of State Investments in Delta Levees and Risk Reduction

A. Fund levee maintenance. Funding for maintenance of levees shall continue to be available throughout the Delta where authorized by Water Code section 12980 et. seq.

B Prioritize levee improvements. The priorities listed below shall guide State discretionary investments in the improvement and major rehabilitation of Delta levees. As DWR selects levee improvement projects for funding through its levee funding programs, it should fund projects at the very high priority islands or tracts, subject to its consideration of the benefits, costs, engineering considerations, and other factors, before approving projects at high priority or other priority tracts. If available funds are sufficient to fully fund levee improvements at the very high priority tracts, then funds for improvements or major rehabilitation of levees on high priority islands and tracts may be provided, and after those projects have been fully funded, then projects at other priority islands and tracts may be funded.

The Department of Water Resources shall certify projects' consistency with this regulatory policy when its funding decisions are made and shall report annually to the Council about its decisions to award State funds for Delta levee improvements, including the location of each funded improvement, the priority of the affected islands or tracts, the improvements funded, including the relevant levee improvement type, habitat mitigation or enhancement features, estimated reduction in levee fragility, expected reduction in annual fatalities and damages, State funds awarded, and local or federal matching funds.

Preliminary Draft Delta Levees Investment Priorities



Very High Priority	BETHEL ISLAND, BISHOP/DLIS-14 (NORTH STOCKTON), BRANNAN-ANDRUS, BYRON TRACT, CENTRAL STOCKTON, DUTCH SLOUGH, GRAND ISLAND, JERSEY ISLAND, MAINTENANCE AREA 9 NORTH, MAINTENANCE AREA 9 SOUTH, MCCORMACK-WILLIAMSON TRACT, NORTH STOCKTON, RECLAMATION DISTRICT 17, SHERMAN ISLAND, TWITCHELL ISLAND, UPPER ANDRUS ISLAND, WEST SACRAMENTO
High Priority	BACON ISLAND, BOULDIN ISLAND, BRADFORD ISLAND, CLIFTON COURT FOREBAY, DLIS-08 (DISCOVERY BAY AREA), DLIS-20 (YOLO BYPASS), DLIS-22 (RIO VISTA), DLIS-63 (GRIZZLY ISLAND AREA), DREXLER TRACT, GLANVILLE, HASTINGS TRACT, HOLLAND TRACT, HONKER BAY, HONKER LAKE TRACT, HOTCHKISS TRACT, JONES TRACT (LOWER AND UPPER), LITTLE EGBERT TRACT, MANDEVILLE ISLAND, MCDONALD ISLAND, MIDDLE & UPPER ROBERTS ISLAND, MOSSDALE ISLAND, NEW HOPE TRACT, PALM-ORWOOD, PARADISE CUT, PARADISE JUNCTION, PESCADERO DISTRICT, STATEN ISLAND, STEWART TRACT, TERMINOUS TRACT, TYLER ISLAND, UNION ISLAND WEST, VICTORIA ISLAND, WEBB TRACT, WOODWARD ISLAND
Other Priority	ATLAS TRACT, BIXLER TRACT, BRACK TRACT, CACHE HAAS AREA, CANAL RANCH TRACT CHIPPS ISLAND, CONEY ISLAND, DEAD HORSE ISLAND, DLIS-01 (PITTSBURG AREA), DLIS-06 (OAKLEY AREA), DLIS-07 (KNIGHTSEN AREA), DLIS-10, DLIS-15, DLIS-17, DLIS-18, DLIS-19 (GRIZZLY SLOUGH AREA), DLIS-25, DLIS-26 (MORROW ISLAND), DLIS-27, DLIS-28, DLIS-29, DLIS-30, DLIS-31 (GARABALDI UNIT), DLIS-32, DLIS-33, DLIS-34, DLIS-35, DLIS-36, DLIS-37 (CHADBOURNE AREA), DLIS-39, DLIS-40, DLIS-41 (JOICE ISLAND AREA), DLIS-43 (POTRERO HILLS AREA), DLIS-44 (HILL SLOUGH UNIT),DLIS-46, DLIS-47, DLIS-48, DLIS-49, DLIS-50, DLIS-51, DLIS-52, DLIS-53, DLIS-54, DLIS-55, DLIS-56, DLIS-57, DLIS-59, DLIS-62, DREXLER POCKET, EGBERT TRACT, EHRHEARDT CLUB, EMPIRE TRACT, FABIAN TRACT, FAY ISLAND, GLIDE DISTRICT, HOLT STATION, KASSON DISTRICT, KING ISLAND, LIBBY MCNEIL, LISBON DISTRICT, LOWER ROBERTS ISLAND, MCMULLIN RANCH, MEDFORD ISLAND, MEIN'S LANDING, MERRITT ISLAND,NETHERLANDS, PEARSON DISTRICT, PETERS POCKET, PICO-NAGLEE, PROSPECT ISLAND, QUIMBY ISLAND, RANDALL ISLAND, RINDGE TRACT, RIO BLANCO TRACT, RIVER JUNCTION, ROUGH AND READY ISLAND, RYER ISLAND, SHIMA TRACT, SHIN KEE TRACT, STARK TRACT, SUNRISE CLUB, SUTTER ISLAND, UNION ISLAND EAST, VEALE TRACT, VENICE ISLAND, WALNUT GROVE, WALTHALL, WETHERBEE LAKE, WINTER ISLAND, WRIGHT-ELMWOOD TRACT, YOLANO

DLIS Priorities

When DWR's contributions towards levee improvements vary from these priorities, it shall identify how the funding is inconsistent with this guidance, describe why variation from the priorities is necessary, and explain how the funding nevertheless protects lives, property, and the State's interests in water supply reliability and restoration, protection, and enhancement of the Delta ecosystem while considering the Delta's unique agricultural, natural, historic, and cultural values. That determination is subject to review by the Delta Stewardship Council on appeal.

(a) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that involves discretionary State

investments in the improvement and major rehabilitation of Delta levees. Nothing in this policy establishes or otherwise changes existing levee standards.
NOTE: Authority cited: Section 85210(i), Water Code.

Reference: Sections 85020, 85300, 85305, and 85306, Water Code.

Definitions

Add the following definitions to the Delta Plan glossary

Levee Maintenance:

Annual or routine levee maintenance is work intended to preserve the levee system in its current condition. Examples of maintenance work include patrols, surveys and inspections, extermination and control of burrowing animals, work on the levee crown to improve access or drainage, removing vegetation or debris, control of seepage and boils, cleaning drains and toe ditches, restoring rock protection, and maintenance of levee-related habit improvements sites.

Levee Rehabilitation:

Rehabilitation is levee repair work needed to improve the levee integrity and preserve existing flood risk reduction benefits. Examples of rehabilitation work include raising the levee crown to offset subsidence, flattening waterside slopes, constructing landside berms, and widening levee crowns.

Levee Improvement:

Levee improvements are intended to reduce the probability of flooding. An example of a levee improvement would be changing a levee geometry to meet a higher levee standard such as improving a levee to reach a 200-year level of protection.

Update Flood Management Funding Strategies

The responsibility for securing funding for Delta levee maintenance, repairs, and improvements lies with the numerous local levee- maintaining agencies (primarily reclamation districts). These local agencies have varying ability to pay which is influenced by the value of land within the district that can be assessed and the desires of the district's voters, who are usually property owners. Funding is generated through property assessments of local landowners and also is provided by the State under programs administered by DWR, including the Delta Levees Special Flood Control Projects and Delta Levees Maintenance Subventions programs. Federal investments match State and local funds to improve project levees that protect urban and urbanizing areas. The record of declining flooding damage and testimony to the Council reflect these programs' value. These programs should be continued with adequate funding to provide State matching funds for addressing Delta flood risk.

Many other entities that benefit from flood risk management are not assessed, nor do they contribute to maintenance and upkeep of Delta levees, including owners of regional infrastructure that crosses the Delta. The duty of providing for Delta flood risk management should be borne by all entities benefitting from these actions, and an equitable methodology of defining and apportioning assessments should be developed and implemented.

Problem Statement

Currently available funds are insufficient to meet needs for levee maintenance and improvement in the Delta. Further funds are needed. Additional funding strategies need to be fully evaluated. No mechanism exists for ensuring that costs of levee maintenance are borne by all beneficiaries. Current financing emphasize levee maintenance and improvement, rather than a full array of flood risk reduction measures.

Policies

No policies with regulatory effect are included in this section.

Recommendations

RR R3. Provide adequate State funds to support levee maintenance and improvement

Adequate State funds to support levee maintenance and improvement should continue to be provided through the Delta Levees Maintenance Subventions Program, the Delta Levee Special Projects Program, and through programs that implement the Central Valley Flood Protection Plan.

RR R4. Update Delta Levees Maintenance Subvention Program's Cost-sharing Provisions

A. **75 percent State cost share**. The Delta Levees Maintenance Subvention Program's maximum 75 percent State cost share for maintenance and major rehabilitation projects should be extended indefinitely.
B. **Update the Delta Levees Maintenance Subventions Program Deductible Provision**. The Legislature should amend the Water Code section 12986(a)-(b) to adjust the current $1000 per mile deductible amount to account for inflation since the provision was enacted in 1981. The deductible amount should be reevaluated periodically to reflect current inflation and the needs of the program and its participants.
C. **Simplify Consideration of Local Levee Maintaining Agencies' Ability to Pay for Levee Maintenance and Improvement**. The Central Valley Flood Protection Board should revise its guidelines for the Delta Levees Maintenance Subventions Program to provide a simplified approach to the consideration of a local levee agency's ability

to pay for the cost of levee maintenance or improvement, as required by Water Code section 12986(a)(3), so that reclamation districts with little ability to pay receive the full 75 percent State cost share recommended above, with reduced State cost shares for reclamation districts that are able to pay more to maintain and improve their levees.

RR R5 Finance Local Flood Management Activities

The Council, DWR, CVFPB, and the DPC, in consultation with the Corps of Engineers and the Department of Finance, should cooperate to further develop levee finance mechanisms, including those studied by the DPC, that create opportunities for "beneficiary pays"-based funding approaches that supplement State-funding for levee maintenance and improvements. Because no single financial mechanism can meet the requirements of a beneficiary-pays approach to address the full range of beneficiaries and financing needs, a portfolio of mechanisms targeted to particular levee improvements should be evaluated. These mechanisms could include assessments, public funding, water use fees, water conveyance fees, and flood prevention fees.

RR R6. New State Funding for Non-structural Risk Reduction

A hazard mitigation program, funded by the State, should be established to make grants to local governments and flood management agencies to support emergency preparedness actions, such as evacuation planning or prepositioning of flood fight materials, and non-structural flood hazard mitigation actions, such as flood-proofing of public or private buildings or the purchase and removal of flood-prone structures.

RR R7. Fund Actions to Protect Infrastructure from Flooding and Other Natural Disasters

- The California Public Utilities Commission should immediately commence formal hearings to impose a reasonable fee for flood and disaster prevention on regulated privately owned utilities with facilities located in the Delta. Publicly owned utilities should also be encouraged to develop similar fees. The California Public Utilities Commission, in consultation with the Delta Stewardship Council, the California Department of Water Resources, and the Delta Protection Commission, should allocate these funds among State and local emergency response and flood protection entities in the Delta. If a new regional flood management agency is established by law, a portion of the local share would be allocated to that agency.
- The California Public Utilities Commission should direct all regulated public utilities in their jurisdiction to immediately take steps to protect their facilities in the Delta from the consequences of a catastrophic failure of levees in the Delta, to minimize the impact on the State's economy.
- CalTrans should be given authority by the Legislature to enter into agreements with local levee maintaining agencies to fund improvement and maintenance of

levees adjoining interstates and State highways when that is the least cost approach to reducing flood risks to those roads.

- State agencies with projects or infrastructure in the Delta should set aside a reasonable amount of funding to pay for flood protection and disaster prevention.

Manage Rural Floodplains to Avoid Increased Flood Risk

To reduce the risk to lives, property, and State interests in the Delta, additional standards are needed to address new residential development. Sea level rise, subsidence, and new residential development combine to potentially put many more lives at risk. The policies in this section are designed to reduce risk while preserving the Delta's unique character and agricultural way of life. These policies should be construed as those required to provide the minimum level of flood protection, and should not be viewed as encouraging development in floodprone Delta areas. Flood insurance, and awareness of local emergency preparedness and response policies is strongly encouraged for all who live in floodprone areas of the Delta.

Consistent with existing law, urban development in the Primary Zone should remain prohibited. Urban development in the Secondary Zone should be confined to existing urban spheres of influence where the 200-year design standard will be fully implemented by 2025. The 2007 flood risk management legislation (SB 5) contained provisions affecting city and county responsibilities relating to local planning requirements, such as general plans, development agreements, zoning ordinances, tentative maps, and other actions (Government Code sections 65865.5, 65962, and 66474.5).

Future land use decisions should not permit or encourage construction of significant numbers of new residences in the nonurban Delta. For the legacy communities in the Delta, structures developed in these areas are required to meet the legal standard of a 100-year minimum level of flood protection. However, developing and maintaining adequate flood protection remains difficult.

Problem Statement

Continued residential development without adequate flood protection increases risk to lives, property, and State interests in the Delta. Flood risks are expected to grow in light of anticipated climate change effects related to peak flows and sea level rise.

Policies

The appendices referred to in the policy language below are included in Appendix B of the Delta Plan.

RR P2. Require Flood Protection for Residential Development in Rural Areas

a) New residential development of five or more parcels shall be protected through

floodproofing to a level 12 inches above the 100-year base flood elevation, plus sufficient additional elevation to protect against a 55-inch rise in sea level at the Golden Gate, unless the development is located within:

1) Areas that city or county general plans, as of May 16, 2013, designate for development in cities or their spheres of influence;
2) Areas within Contra Costa County's 2006 voter-approved urban limit line, except Bethel Island;
3) Areas within the Mountain House General Plan Community Boundary in San Joaquin County; or
4) The unincorporated Delta towns of Clarksburg, Courtland, Hood, Locke, Ryde, and Walnut Grove, as shown in Appendix 7.

b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that involves new residential development of five or more parcels that is not located within the areas described in subsection (a).

23 CCR Section 5013
NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 85020, 85300, 85305, and 85306, Water Code.

Recommendation:

RR R8. Maintain Lower Risk Uses of Flood-Prone Rural Lands
Agricultural and natural resource land uses and recreational marinas, resorts, or parks are the most appropriate uses for floodprone rural lands and should be maintained, consistent with the regulatory policy Locate New Development Wisely (DP P1).

Protect and Expand Floodways, Floodplains, and Bypasses

Local land use policies guiding development in floodways are not consistent across Delta counties. Floodways have not been established for many of the channels in the Delta by FEMA or by the CVFPB. In light of these inconsistencies, the Delta Plan addresses these issues and highlights the need for the protection of floodplains and floodways consistent with improved flood protection. Over the next 100 years, Delta floodways may expand and deepen because of sea level rise and changing precipitation patterns. Development in existing or potential future designated floodplain or bypass locations in the Delta or upstream of the Delta can permanently eliminate the availability of these areas for future floodplain usage. It is important to identify floodplain areas now for immediate protection and eventual integration into the flood protection system.

Problem Statement

The carrying capacity of the existing flood control system is diminished by encroachments into floodways, critical floodplains, and existing floodplain or bypass

locations in the Delta. Local land use policies guiding development in floodways are not consistent across Delta counties. The existing system is already at suboptimal capacity. Expected changes in sea level rise and runoff patterns due to climate change are expected to exacerbate the problem.

Policies

RR P3. Protect Floodways

a) No encroachment shall be allowed or constructed in a floodway, unless it can be demonstrated by appropriate analysis that the encroachment will not unduly impede the free flow of water in the floodway or jeopardize public safety.
b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that would encroach in a floodway that is not either a designated floodway or regulated stream.

23 CCR Section 5014
NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 85020, 85300, 85302, and 85305, Water Code.

RR P4. Floodplain Protection

a) No encroachment shall be allowed or constructed in any of the following floodplains unless it can be demonstrated by appropriate analysis that the encroachment will not have a significant adverse impact on floodplain values and functions:
    1) The Yolo Bypass within the Delta;
    2) The Cosumnes River-Mokelumne River Confluence, as defined by the North Delta Flood Control and Ecosystem Restoration Project (McCormack-Williamson), or as modified in the future by the California Department of Water Resources or the U.S. Army Corps of Engineers (California Department of Water Resources 2010); and
    3) The Lower San Joaquin River Floodplain Bypass area, located on the Lower San Joaquin River upstream of Stockton immediately southwest of Paradise Cut on lands both upstream and downstream of the Interstate 5 crossing. This area is described in the Lower San Joaquin River Floodplain Bypass Proposal, submitted to the California Department of Water Resources by the partnership of the South Delta Water Agency, the River Islands Development Company, Reclamation District 2062, San Joaquin Resource Conservation District, American Rivers, the American Lands Conservancy, and the Natural Resources Defense Council, March 2011. This area may be modified in the future through the completion of this project.
b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that would encroach in any of the floodplain areas described in subsection (a).
c) This policy is not intended to exempt any activities in any of the areas described in subsection (a) from applicable regulations and requirements of the Central

Valley Flood Protection Board.

23 CCR Section 5015
NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 85020, 85300, 85302, and 85305, Water Code.

Recommendations

RR R9. Fund and Implement San Joaquin River Flood Bypass

The Legislature should fund the California Department of Water Resources and the Central Valley Flood Protection Board to evaluate and implement a bypass and floodway on the San Joaquin River near Paradise Cut that would reduce flood stage on the mainstream San Joaquin River adjacent to the urban and urbanizing communities of Stockton, Lathrop, and Manteca in accordance with Water Code section 9613(c).

RR R10. Continue Delta Dredging Studies

The current efforts to maintain navigable waters in the Sacramento River Deep Water Ship Channel and Stockton Deep Water Ship Channel, led by the U.S. Army Corps of Engineers and described in the Delta Dredged Sediment Long-Term Management Strategy (USACE 2007, Appendix K), should be continued in a manner that supports the Delta Plan and the coequal goals. Appropriate dredging throughout other areas in the Delta for maintenance purposes, or that would increase flood conveyance and provide potential material for levee maintenance or subsidence reversal should be implemented in a manner that supports the Delta Plan and coequal goals. Coordinated use of dredged material in levee improvement, subsidence reversal, or wetland restoration is encouraged.

RR R11. Designate Additional Floodways

The Central Valley Flood Protection Board should evaluate whether additional areas both within and upstream of the Delta should be designated as floodways. These efforts should consider the anticipated effects of climate change in its evaluation of these areas.

Integrate Delta Levees and Ecosystem Function

Setback levees can provide additional levee system stability, more complex land-water interface structure, and shaded riverine aquatic habitat that benefit ecosystem function in appropriate settings. They can also provide flood control benefits in those areas of the Delta not subject to strong tidal influences where channel capacity improvements can actually increase flood-carrying capacity. Not all locations are amenable or useful for setback levee placement. Each site should be investigated for its potential to provide ecological benefits consistent with levee integrity.

Problem Statement

Policies and Recommendations

An updated problem Statement, policies and recommendations regarding the integration of Delta levees and habitat functions will be considered as part of an amendment to the Delta Plan's Ecosystem Restoration chapter.

Renew Federal Assistance for Post-disaster Response

Federal agencies have been essential partners in recovering from prior Delta floods. Changes in these federal programs have reduced confidence about these agencies' assistance in recovering from future floods.

Problem Statement

The loss of federal assurances of assistance in post-flood disaster response hinders planning and may result in significant loss of Delta property and resources.

RR R12. Renew Federal Assistance for Post-disaster Response

The Council, Office of Emergency Services, DWR, Central Valley Flood Protection Board, and Delta Protection Commission should advocate for reforms of the Federal Emergency Management Agency's rehabilitation assistance program, including a renewed hazard mitigation program for Delta levees, and the Army Corps of Engineer's Rehabilitation and Inspection Program (PL 84-99) to account for the economic value of the Delta's water supplies and transportation services and for the State's commitments to reducing Delta flood risk and improving Delta levees.

To facilitate this consideration, priority should be given to research to quantify the economic value of reliable water supplies and transportation services protected by the Delta's levees, including consideration of the levees' contributions to the protection of water quality, water supply infrastructure, and the conveyance of water for export through levee-lined channels.

Limit State Liability

The Delta Reform Act requires that the Delta Plan attempt to reduce risks to people, property, and State interests in the Delta by, among other things, recommending priorities for State investments in levee operation, maintenance, and improvements in the Delta, including project and nonproject levees (Water Code sections 85305, 85306, and 85307). The law expressly states that these provisions do not affect the liability of the State for flood protection in the Delta or its watershed (Water Code section 85032(j)).

Consequently, no action taken by a State agency as required or recommended by, or otherwise in furtherance of, this Delta Plan shall affect State flood protection liability in the Delta or its watershed. Therefore, the Legislature should consider requiring an adequate level of flood insurance for residences, businesses, and industries in floodprone areas.

Problem Statement

As the risks of levee failure and corresponding damage increase, California courts have generally exposed public agencies and the State, specifically, to significant financial liability for flood damages. DWR's 2005 white paper recommends one way that the State should reduce its liability is to require houses and businesses to have flood insurance (DWR 2005).

Policies

No policies with regulatory effect are included in this section.

Recommendations

RR R13. Require Flood Insurance

The Legislature should require an adequate level of flood insurance for residences, businesses, and industries in floodprone areas.

RR R14. Improve Delta Communities' National Flood Insurance Program Community Rating System (CRS) Program Rankings

Delta communities should improve their current National Flood Insurance Program Community Rating System (CRS) ranking through the implementation of risk reduction management practices, when feasible, in order to receive additional discounts on flood insurance premium rates.

RR R15. Limit State Liability

The Legislature should consider statutory and/or constitutional changes that would address the State's potential flood liability, including giving State agencies the same level of immunity with regard to flood liability as federal agencies have under federal law.

This recommendation would be added to the Delta Plan's Chapter 5, which addresses Delta as Place issues, including recreation:

DP RXX. Provide Public Access on Appropriately-located Delta Levees

When using state funding to improve levees in the Delta that border urban areas, unincorporated Delta towns, publicly-owned nature areas, or other public lands or that intersect with state highways, the levee designs and associated land purchases should consider public access, including but not limited to bank fishing, nature observation, or pedestrian and bicycling trails. When agencies make decisions about funding levee improvements they should identify the types of public access or recreation that may be

feasible at the levee and explain how they have considered those opportunities in their decision.

Issues for Future Evaluation and Coordination

The following list of issues should be considered in future updates of the Delta Plan. These and other issues will need to be considered as additional information and materials become available. The various activities called for in this Delta Plan, as well as issues that arise from other planning efforts, such as the Central Valley Flood Protection Plan, will be considered. Additional areas of interest and concern related to flood risk in the Delta may deserve consideration in the development of future Delta Plan updates, including:

- **Reoperation of Upstream Reservoirs and Peak Flow Attenuation:** Reservoir operations upstream of the Delta can have substantial impacts on flood flows through the Delta; therefore, operation procedures among government agencies should be well coordinated and, where possible, focused more on flexibility to prevent flooding in the Delta. Water Code section 85309 directs DWR to develop a proposal to coordinate flood and water supply operations with appropriate State and federal agencies, and this shall be considered by the Council for future inclusion in the Delta Plan.
- **Post-disaster Recovery:** Future reviews of this chapter should more thoroughly consider post-disaster flood responses, including whether not reclaiming some flooded islands could provide ecological benefits that might outweigh the advantages of recovering and dewatering the islands.
- **Utility Corridor Consolidation:** An attempt to consolidate infrastructure into "utility corridors" as facilities are added and upgraded over time should be further investigated to determine whether this can allow for better management of flood risk consequences to these critical assets.
- **Strategies to Accommodate To Climate Change and Rising Sea Levels:** The Council should continue to (a) participate in the Natural Resources Agency's Climate Action Team and adapt to changing estimates of sea level rise when they become available and (b) consult with Caltrans regarding the potential effects of climate change and sea level rise on the three state highways that cross the Delta (Water Code section 85307(c)). Opportunities to assist local Delta agencies in assessing their vulnerability to rising sea levels should be explored.
- **Governance**. Because the number and diversity of agencies involved in levee maintenance, improvement, and oversight complicates coordination and effective management of the Delta's levee network, opportunities to improve governance should be explored. This could include reorganization of State agencies' oversight responsibilities in fewer agencies. Opportunities for joint powers agencies or other consolidations of reclamation districts or other local levee maintaining agencies should also be considered.

Science and Information Needs

The Delta system and its influencing factors are not static. The analysis and data gathered to support the Delta Levees Investment Strategy provided an updated foundation of information regarding risk of levee failure in the Sacramento-San Joaquin Delta and the impacts to State interests. However, newer data are always being developed and methods of analyzing it or estimating impacts can always be improved; therefore, research is needed to better understand dynamic issues such as climate change, seismicity, sea level rise, subsidence, and other areas. Continuing investigations into the science, engineering, and economic aspects of the Delta are critical to adaptively managing for expected and unexpected changes, and can provide decision makers and stakeholders with key information for future planning and decision making. Specifically, additional information will be needed in the following areas:

- Levee conditions, including their geometry and structural makeup, in order to provide better estimates probability of failure.
- Updates of information about the population protected by Delta levees, coordinated with periodic censuses, and about Delta assets such as land use, property value and infrastructure as data becomes available.
- Possible levee failures' potential to (a) impair water quality and disrupt water supplies, including supplies for in-Delta users and regional suppliers in addition to the SWP and CVP and (b) damage neighboring islands.
- Interactions between Delta levees and ecosystem function, including the impacts of levee failures on important Delta ecosystems.
- Improved forecasts of sea level rise and other climate change impacts on flood risk, and incorporation into risk reduction criteria.
- Effects of seismicity on levee integrity, including expanded observations of Delta ground motions, improved estimates of geologically recent displacement on faults beneath the Delta, and further identification of liquefiable materials and mechanisms beneath levees.
- Updated flood stage-probability functions.
- Understanding the impacts on floodplain ecosystems and Delta flood management from upstream flood management infrastructure operations, including reservoir operations.
- Technologies for assessing levee integrity.

Efforts to address these needs and others that arise during Delta Plan implementation should be undertaken in a systematic fashion so that information developed and lessons learned can be incorporated into future Delta Plan updates.

Performance Measures

Final administrative performance measures are listed in Appendix E.

Outcome Performance Measures

No increase in loss of life in the Delta as a result of flood emergencies and decrease in expected annual fatalities or expected annual property damages. (Strategy 7.1)

Target:

- Zero lives lost from floods.
- 50 percent decrease in expected annual fatalities by 2025.
- 50 percent decrease in expected annual property damages by 2025.

Metrics:

- Number of lives lost in the Delta as a result of flood emergencies.
- Expected annual fatalities (EAF) for the Delta
- Expected annual damages (EAD) in the Delta).

Baseline:

- Number of lives lost within the Delta in recent history is zero according to the National Oceanic and Atmospheric Administration's Storm Events Database, which details events dating back to 1950.
- Expected annual fatalities and expected annual property damages reported in 2017, as reported in Delta Levee Investment Strategy final report.

Water delivery interruptions by floods or earthquakes in the Delta. (Strategy 7.3)

Target: No water delivery interruptions.

Metrics:

- Number of water delivery interruptions caused by floods or earthquakes in the Delta.
- Acre-feet of water not delivered due to disruptions caused by floods or earthquakes in the Delta.

Baseline:

N/A because this measure has a prescribed target and is not showing a change from a baseline.

Increase in community credit points in National Flood Insurance Program (NFIP) Community Rating System. (Strategy 7.3 and Strategy 7.7)

Target: Increase in community credit points in the NFIP Community Rating System by 2025.

Metrics:

- Community Rating System credit points of Delta communities participating in the NFIP.

Baseline:

Community Rating System credit points at the time of Delta Plan adoption, May 2013 or nearest available date.

Output Performance Measures

Responsible local, State, and federal agencies with emergency response authority implement the recommendations of the Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force (Water Code section 12994.5) by January 1, 2014. (Strategy 7.1)

Target: 100 percent (11/11) of recommendations implemented.

Metrics: Percent of recommendations implemented.

Baseline: 0 percent (0/11) of recommendations implemented.

Level of flood risk reduction provided by Delta levees. (Strategy 7.3)

Target: 100 percent of urban communities in the Delta protected by levees meeting DWR's urban level of flood protection criteria. 100 percent of rural Delta islands and tracts protected by levees at or above Bulletin 192-82/ PL 84-99 criteria.

Metrics:

- Percent of urban communities in the Delta protected by levees meeting DWR's urban level of flood protection criteria.
- Percent of Delta land protected by levees at or above the Bulletin 192-82/PL 84-99 standard.

Baseline:

Percent of urban communities in the Delta protected by levees meeting DWR's urban level of flood protection criteria and percent of Delta islands and tracts protected by levees at or above the Bulletin 192-82/PL 84-99 standard at the time of Delta Plan adoption, May 2013.

Consideration of sea level rise in flood protection planning for new residential

development. (Strategy 7.4)

Target: 100 percent of proposed actions to which RR P2 are applicable meet the requirements of RR P2.

Metric: Number of proposed actions covered by the Delta Plan policy to require flood protection for residential development in rural areas (RR P2).

Baseline: N/A because this measure has a prescribed target and is not showing a change from a baseline.

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